Wildlife Economics and Productivity Analysis Guide

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Preface

This guide describes biological and economic procedures developed by the Bureau of Land Management (BLM) to evaluate the biological effects and economic benefits of BLM's resource improvements and treatments, especially habitat improvements, affecting wildlife populations. Although developed as part of an instructional package for teaching BLM resource managers to use BLM procedures for benefit-cost analysis and project ranking, this expanded publication is also intended to provide a basic level of knowledge and understanding of wildlife economics and productivity analysis. We hope that it will help resource managers become a more effective force for ecologically sound and economically efficient wildlife management on the public lands.

This guide breaks some new ground by linking biological analysis with economic analysis through limiting factors analysis. Wildlife and fisheries productivity analysis (WFPA) is a quantitative technique for biologists to use to make projections of the effects of proposed actions on wildlife populations. Without such quantitative projections, there can be no numerical benefit-cost analysis. In addition, this guide provides systematic methods for incorporating the consumptive and nonconsumptive values of wildlife into BLM's investment analysis procedures. A third element that was considered for inclusion was guidance on estimating the nonconsumptive use values of wildlife, such as existence and bequest value. However, since we were unable to adequately quantify these values, we settled for providing procedures which require qualitative consideration of these values in ranking projects and in choosing how to spend BLM funds for resource improvements and treatments. We believe this is the appropriate way of accounting for the value of preserving endangered species or any species whose population is not used widely for recreation. By using existence value and preservation value in ranking choices, we confront the economic cost of protecting these unique biological resources and judge the desirability of different plans for protection against their costs—the essence of benefit-cost analysis. Whether measuring everything in dollars or dealing in unquantified values, the goal is still to make the most economic use of existing funds and resources by considering all costs and benefits that can be recognized, described, and evaluated.

This guide is written for biologists and other resource specialists, economists, other social scientists, planners, and managers. Some basic economics is included for biologists who may be working without readily available economic expertise. A more advanced discussion of economics is included in the appendices. We expect economists and other social scientists to benefit from some of the expert sections and appendices because of the responsibility they may have for advising on technical matters, developing information on demand, and for determining prices to be used in estimating benefits. An appendix on regional economic impact analysis is included for those resource specialists who need to work with this technique as well as with benefit-cost analysis. The distinctions between these two kinds of economic analysis are often confused by economists and noneconomists alike. Biologists need to know that their biological analyses can serve both kinds of economic analysis equally well, but that benefit-cost analysis and not regional economic analysis is the focus of this guide.

Managers play an essential role in investment analysis. The Executive Summary and Chapter 5, "Strategies for Ranking Choices," have been written with managers in mind. Managers must believe in the analysis and use it. If not, BLM will be unable to document a record of logical, consistent decision-making.

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Executive Summary

BLM needs wildlife economics as a management tool because wildlife has become economically important on the public lands. The willingness-to-pay for wildlife uses of BLM lands for hunting, fishing, and viewing is estimated conservatively to be in excess of $200 million annually (in 1985 dollars). This estimate places wildlife on an equal footing with the market value of grazing and timber combined.

Because the public lands are the largest single reservoir of wildlife habitat remaining in the nation, the choices about the management of this habitat have become crucial to the welfare of the thousands who enjoy wildlife through recreation.

Wildlife has value in use and in nonuse. Wildlife is valued for hunting, fishing, photography, and viewing. But it also has a high nonuse value—the recognition that wildlife is an integral part of the natural diversity of the landscape and that it is necessary for a properly functioning ecosystem.

Knowledge of the biological response of wildlife to resource improvements and treatments, and knowledge of dollar values of wildlife-related products of the public lands, are essential to wildlife economics and productivity analysis because these values permit calculation of the economic value of a change in wildlife habitat. Such calculations do not eliminate the guesswork in habitat management, but they provide a quantitative tool to assist in decision-making.

This guide describes BLM's process for wildlife economics and productivity analysis. The process consists of four stages. The first three stages produce the benefit-cost analysis used in the fourth, or project ranking stage. The four stages are:

Stage 1 - Biological Response

Using the concept of limiting factors, this stage predicts the population numbers of priority or featured species at a specified future time with and without proposed actions. It also predicts the percentage of game populations that may be harvested in a biologically sound manner at that future date with and without the proposed action.

Stage 2 - Change in Use

This stage uses the predicted difference in population or allowable harvest as a result of the proposed action to further predict a potential change in use (expressed as user days). Nonconsumptive use is assumed to change in the same proportion as consumptive use.

Stage 3 - Benefit-Cost Calculation

At this stage, dollar values per user day are multiplied by the change in the number of user days to get the total benefits (or losses) from the change in use associated with the proposed action. All project costs and benefits are combined and discounted over the life of the project to produce a benefit-cost ratio (B/C). If benefits equal costs, then the B/C will be 1.0. This value normally divides positive from negative projects, where there are no further subjective elements involved in the decision.

Stage 4 - Ranking Projects

In the final stage, managers work with resource specialists to rank all the projects using the benefit-cost estimates in addition to other social, political, and environmental information. The ranking process is both qualitative and deliberative, with the B/Cs serving as one of several considerations.

Wildlife economics and productivity analysis is a tool for making choices. Conscientious use of these procedures should result in better management decisions about land management practices that affect wildlife.

Chapter 1 - Introduction

The Federal Land Policy and Management Act (FLPMA) directs the BLM: "Use a systematic, interdisciplinary approach to...integrate...physical, biological, economic, and other sciences" [Federal Land Policy and Management Act of 1976 Section 202(c)(2)]. Such interdisciplinary approaches often require biologists to place dollar values on wildlife resources so they can be considered in the same terms as other costs and benefits of land management. Yet wildlife biologists hesitate to put dollar values on wildlife. To say that a bighorn sheep is worth ***x*** dollars, a chinook salmon is worth ***y*** dollars, and a bald eagle is worth *z* dollars seems unfair, unethical, and wrong. At first glance, the reasoning and methodologies of economics do little to assuage the average biologist's aversion to valuing wildlife. But, consider the following.

In the 1985-1986 season, there were 5 million days of hunting on BLM lands and over 3 million days of fishing. Conservatively, the willingness-to-pay value of this hunting and fishing was $200 million. Add to this over 2 million days spent on BLM lands primarily viewing wildlife with a value of over $63 million, and the primary uses of wildlife on BLM lands approach $300 million. These values do not count the 230 million hours spent on BLM lands in other kinds of recreation to which wildlife contributed some values (USDI, Bureau of Land Management 1987; Connelly and Brown 1988).

These wildlife values are not being adequately translated into quantifiable data for project planning and analyses. Many biologists are still arguing that wildlife is great, valuable, necessary, or just very important. This approach doesn't always work because not everyone has the same natural appreciation for wildlife values. Biologists need to use the science of economics to quantify wildlife values. The dollar is the quantifiable value that most people understand. Biologists often believe that since opportunities to hunt, fish, or view wildlife cannot be purchased in an organized market, the value of such opportunities cannot be quantified. Techniques for estimating such values are available though and dollar values for wildlife often come out higher than expected.

Substantial progress has been made in determining the economic value of many consumptive and nonconsumptive uses of wildlife such as elk hunting, salmon fishing, and wildlife viewing. But, the quantification of other wildlife values is not as well developed. These include values such as:

- Option value - what it's worth to knowthat the species is there to see or otherwise use if you decide to.
- Existence value - what it's worth to a person just to know the species exists.
- Bequest value - what it's worth to a person to be sure the species exists for future generations.

These values are difficult to quantify, but they are real and often dwarf the consumptive values.

We recognize that our inability to quantify the value of an entity or a phenomenon does not mean there is no value. Furthermore, many ecological values, including the value of a species or an ecosystem, may defy valuation. Modern holistic thinking about ecosystems suggests that a species cannot be separated from an ecosystem for analysis and that a sustainable ecosystem is not a quantifiable value.

Most of these concerns are not applicable in the context of the analyses described in this guide. The valuation procedures described in this guide are for use on relatively common species within a limited range of densities well above an extirpation threshold. Allowable harvest figures are based upon a sustainable level; thus, sustainability is an underlying constraint upon the whole process described in this guide. Use of intangibles as ranking factors is introduced to compensate for the limits of economic valuation.

As Davis (1985) pointed out, economics is "the science of choosing" and the payoff is better management decisions. The payoff for using wildlife economics is that the value of wildlife is properly considered in land management decisions.

In summary, wildlife economics provides not only a necessary tool for professional resource managers, but a powerful tool that biologists will want to use because it demonstrates what they knew all along—wildlife is valuable.

Types of Economic Analysis

Two types of economic analysis, investment analysis and regional economic impact analysis, are often confused. Traditionally, biologists and economists talk about wildlife economic benefits as though they consisted only of recreationists' expenditures for hunting and fishing equipment, binoculars, cameras, travel, meals, and lodging. These expenditures are translated by the methods of regional economic impact analysis into increases in local income and employment. But expenditures are only the indirect benefits of wildlife to a local economy.

Investment analysis deals with the direct benefits of enjoying wildlife—the increases in well-being derived by people who use wildlife. Recreationists' willingness-to-pay values are used to identify the most efficient investments (e.g., in resources, improvements, and treatments) with the highest rates of return to the nation as a whole. This guide deals mainly with investment analysis.

Regional economic impact analysis is used in resource management planning and environmental impact analysis to estimate the effects of alternative land use plans or proposed actions on regional income and employment. Such analysis, however, is limited to a region or locality rather than to the nation as a whole. Although regional economic impact analysis is not described in the main portion of this guide, further information on it can be found in Appendix III.

The Project Evaluation Thought Process

Before a specific improvement or treatment project can be given serious consideration, several questions should be asked. These questions provide the framework of a thought process that can and will become a natural part of project evaluation and planning. This thought process is in fact the basis for much of the more formal economic analysis described in the following chapters. The questions to be asked include:

- Have the management objectives been identified?
- Will the proposed project achieve these objectives?
- Have all the alternatives been considered, such as:
  - -changes in management rather than structural changes?
  - -other types of activities?
- How do the costs of the alternatives compare?
- Will the expected benefits equal or exceed the costs?
- Do the costs include mitigation of adverse impacts?
- Will funds be available for project installation, maintenance, and reconstruction when needed?
- What priority does the proposed project have?
- Are funds being allocated to projects that yield the highest return on investments?

The procedures described in this guide are designed to provide a systematic approach to address these questions.

Procedure for Wildlife Economics and Productivity Analysis

Wildlife economics and productivity analysis consists of four stages. The first three stages, biological response, change in use, and benefit-cost analysis, produce the benefit-cost data used in the fourth or project ranking stage.

Stage 1 - Biological Response

In the first stage of the process, a biologist estimates the effect of a proposed action on limiting habitat factors and thus on population numbers. One must first identify priority or featured species. These are generally species sought for consumptive use (e.g., hunting) or nonconsumptive use (e.g., birdwatching), whose utility of use is related to population numbers.

The next step is to identify qualitatively how a management action will affect habitat for the priority species. If no impacts on habitat factors can be identified, then the source of information is identified and the analysis is complete. If, however, positive or negative effects are identified, proceed to quantitative analysis.

At this point, the limiting habitat factors are identified. These factors can potentially limit the wildlife population and should be stated as specifically as possible. Numerical ratings for each factor must be determined. These ratings are the estimated percentage of optimum at which the factor exists at present, at a future time with the action, and at a future time without the action. This improves upon the traditional "before and after" approach to impact analysis. It allows for trends in the habitat, such as plant succession, that occur without the proposed action and which could affect the size of the anticipated benefits. Next, having identified potentially limiting factors, identify the actual limiting factor as the factor with the smallest rating at a given time. A limiting factor will exist with and without the proposed action and at present, although the limiting factor may be different at each of these points in time.

Next, the optimum population level is identified. This may be thought of as the carrying capacity of the habitat area when all habitat factors are optimum. The biologist then calculates the population level at the present and at a future time both with and without the proposed action as a function of optimum population level and the limiting factor at each of these stages. The biologist then identifies the percentage of this population that can be harvested, based on biological considerations. These two numbers are used to calculate allowable harvests for the present situation, conditions with the project, and conditions without the project. Next, the number of years for the change in population to occur with and without the project are identified. And finally, the expected change in population or change in harvest due to the action is calculated.

Stage 2 - Change in Use

The next stage requires that the change in allowable harvest or population be used to predict a potential change in use (expressed as user days). A change in user days is calculated as:

(change in harvest) x (user days per unit of harvest)
or
(change in population) x (user days per unit of population)

In either formula, the information normally used comes from state fish and game agencies' statistics on hunting and fishing pressure, harvests, and population estimates.

Stage 3 - Benefit-Cost Analysis

At this stage, prices or values per user day are multiplied by the change in number of user days to get total benefits (or losses) as a result of the proposed action. These prices are based on studies of willingness-to-pay in each state. All project costs and benefits are then used, with proper discounting, to calculate a B/C for the project. Discounting produces a weighted sum of the annual costs and benefits over the life of the project by giving progressively less weight to successive future years.

BLM developed a computer program in Denver in 1982 called SageRam. The program ran on a mainframe computer and performed benefit-cost calculations on range improvements. The advantages of SageRam were its interactive design and its categories of benefits and costs which were specific to BLM resource investments. SageRam was replaced in August 1992 with a personal computer (PC) version called Resource Investment Analysis, Investment Analysis Model (IAM).

If benefits equal costs, the B/C will be 1.0, normally the dividing line between good and bad projects. Projects with a B/C of <1.0 are frequently developed because of subjective judgments concerning benefits or costs which could not be reflected in the quantitative analysis. BLM has no rule that automatically rejects projects with a B/C of <1.0, a favorable situation because such rules encourage overestimation of benefits and underestimation of costs.

Stage 4 - Project Ranking

The final stage requires a manager, with support from biologists and other resource specialists, to rank all projects. The staff furnishes results of investment analysis, the B/C, and other social, political, and environmental information. During this stage, important environmental considerations such as effects on nongame species, unique natural communities, or threatened and endangered species, are identified. The ranking process thus becomes qualitative and deliberative with the B/C as only one of several considerations.

Chapters 2, 3, and 4 of this guide describe the first three steps in the process and Chapter 5 describes the ranking procedure. Appendices I and II provide additional information on wildlife values and other economic questions as references. Appendix III describes and illustrates regional economic impact analysis for biologists and other specialists who need to work on studies for Resource Management Plans (RMPs) or Environmental Impact Statements (EISs).

Chapter 2 - Productivity Analysis

This chapter provides guidance on how to estimate the increase or decrease in the numbers of a particular species (wildlife productivity) that may occur as a result of a project or other proposed action. It presents a flexible method for calculating changes in wildlife productivity and documenting the data sources, assumptions, and results, all of which are necessary if a benefit-cost analysis is to be performed and to become part of the record of a management decision.

Wildlife and fisheries productivity analysis (WFPA) does not require judgment of the economic value of changes in population numbers. Rather, it is a method for documenting the user's thought processes and calculations when assessing the effects of a particular proposed action on wildlife or fisheries populations.

This technique also provides a needed shift from the traditional way of viewing the effects of proposed actions. Rather than comparing the effects before and after an action, WFPA compares effects with and without the action. This comparison requires the user to consider habitat trends, such as succession, that are occurring independently of the proposed action. The differences in these two approaches are shown in Figures 2-1 and 2-2. In the "before and after" analysis (Figure 2-1), the size of the wildlife population is P_1 before the proposed action and P_2 after the action at time T_2. The change in population size or change in productivity (ΔP) is traditionally seen as simply $P_2 - P_1$. In the "with and without" analysis of WFPA (Figure 2-2), the population size of the species also has a value of P_1 before the action and P_2 after the action at time T_2. But we must estimate a value for P_3, the productivity at time T_2, without the proposed action. The change in population size or productivity (ΔP) is then $P_2 - P_3$.

The change in population size or productivity shown in Figure 2-2 better represents what really happens in wildlife habitats, which are rarely in a static condition. Whether or not a proposed action takes place, some habitat factors will be changing. Of course, P_2, P_3, or both could also be less than P_1, and the lines from P_1 to P_2 and P_3 usually are not straight. WFPA forces us to think critically about our assumptions, which otherwise are often neither stated nor even recognized. Once the assumptions are written down for the user and others to evaluate, the whole analysis will be improved. If another person does not agree with an assumption, it can be reexamined. A productive discussion may solve the problem.

WFPA also requires that specific population data and its sources be recorded, allowing others to evaluate these numbers. Because all such data are subject to sampling error, the user is expected only to document the best existing information. If the best information is based only on professional judgment, then that is the starting point. Since all the critical information needed for an analysis is documented, the analysis can be improved over time. For example, the pronghorn density in an area is assumed to be 1/238 acres (1/km^2) and a proposal is made to put in five water developments to increase the density to 4/238 acres (4/km^2). The analysis is documented and building begun on the developments at the rate of one per year. After 2 years, better data reveals that the density is close to 4/238 acres (4/km^2). At that point, the analysis should be reworked to decide if the remaining three developments are cost effective or are needed to meet pronghorn population objectives.

The analyses need not take long to complete. The minimum documentation option for minor projects should take only a few minutes. For larger, more complex projects, such as Habitat Management Plans (HMPs), Allotment Management Plans (AMPs), and Resource Management Plans (RMPs), this technique may actually save time by providing a logical structure for organizing information.

Concepts

The basic concepts used in the WFPA worksheet are described here and are then followed by a step-by-step description of how to fill in the worksheet.

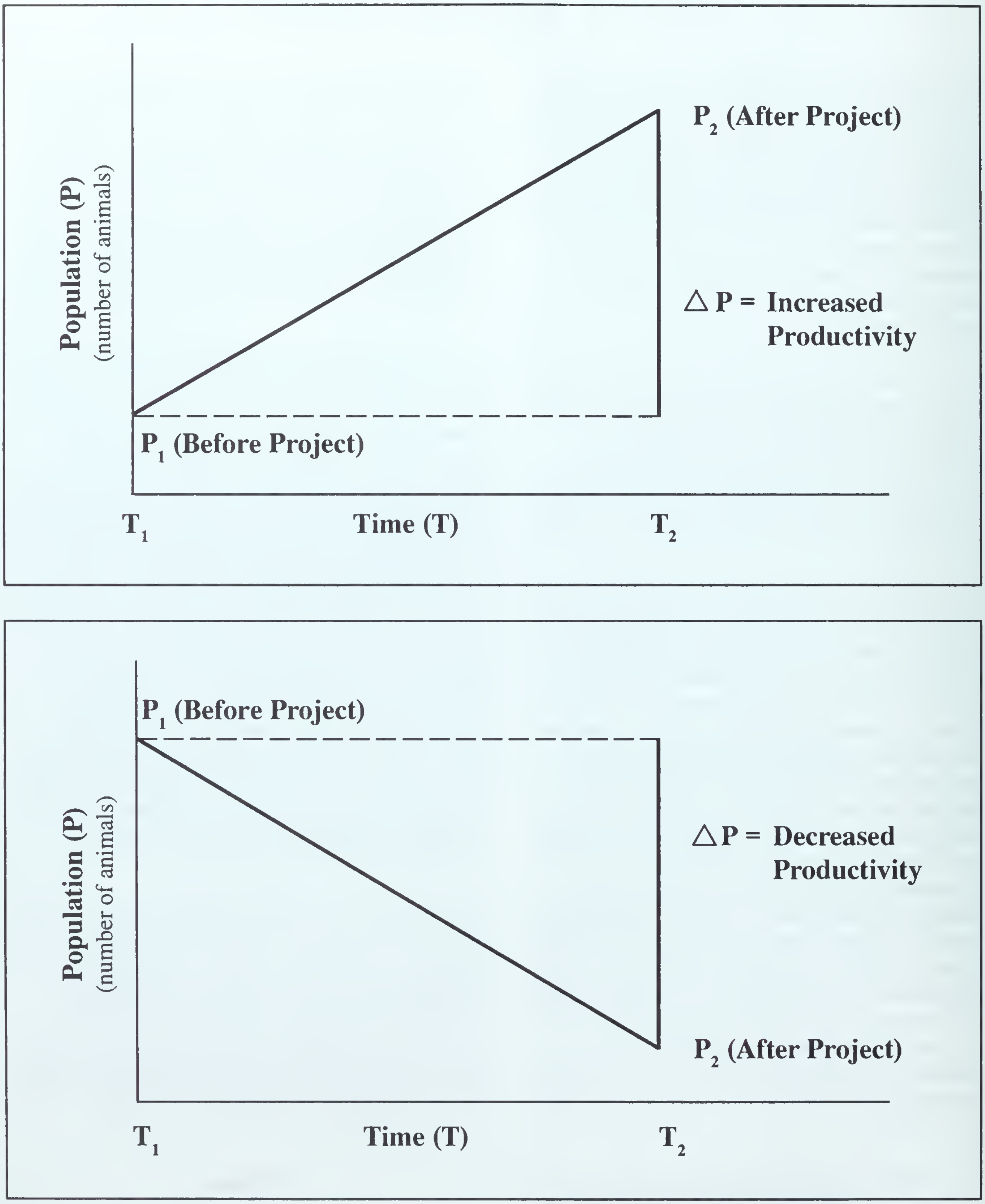

FIGURE 2-1. Before and after approach to determining changes in a population due to a proposed action.

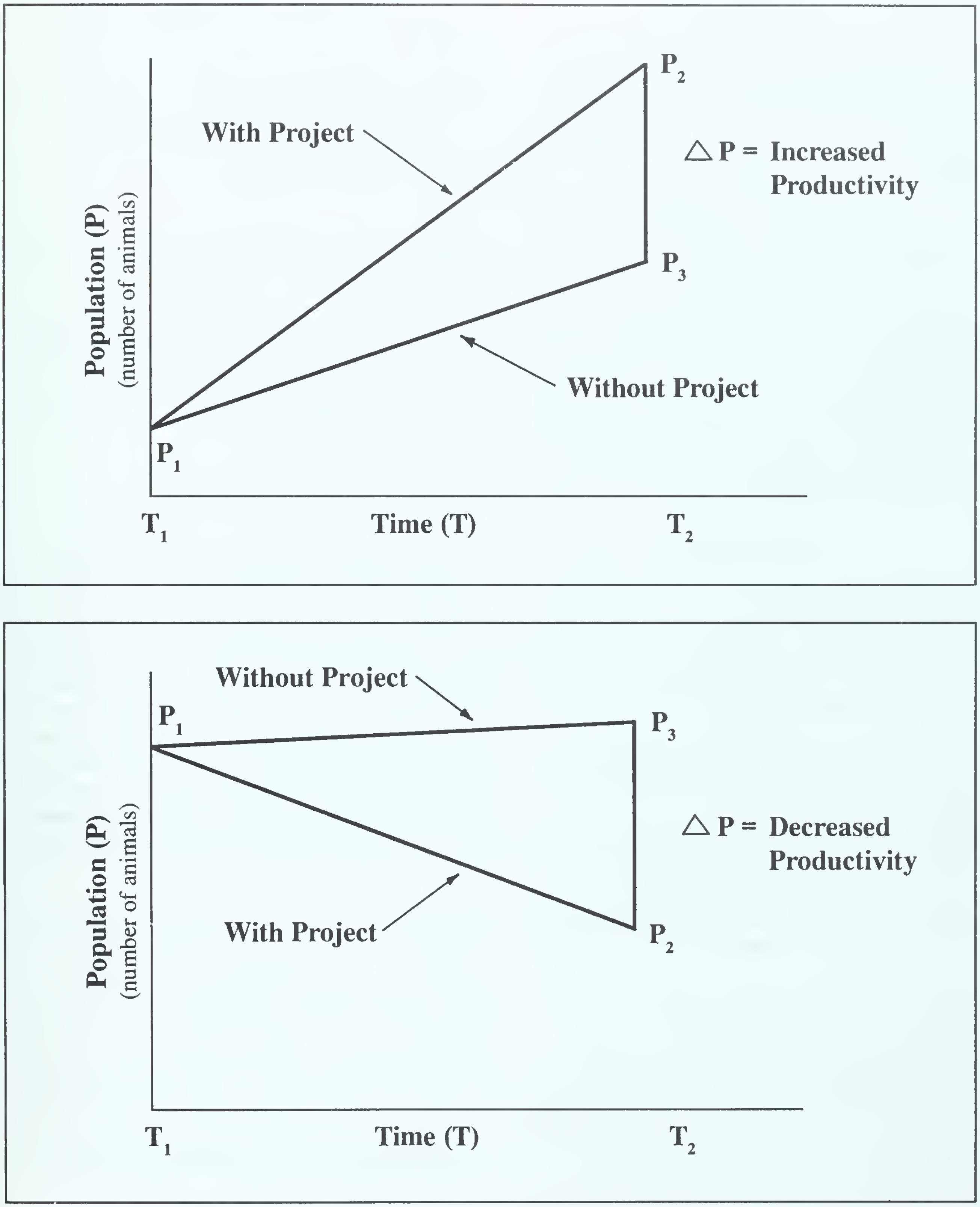

FIGURE 2-2. With and without approach to determining changes in a population due to a proposed action.

Priority Species

One of the WFPA requirements is the selection of a priority or featured species or group of species for analysis. Several factors can affect which species are used in the analysis. Examples of species that are likely to be selected include:

- Species with specific management goals defined in land use or activity plans.
- Federal or state-listed, threatened or endangered species or candidate species.
- Species representative of an entire life form or guild whose management will meet the habitat requirements of several other species.
- Species whose economic value is high for either consumptive or nonconsumptive purposes.
- Species of public interest.
- Species of scientific value.

Habitat Factors

Leopold (1933) classified the factors that affect a wildlife population. A brief overview of his classification will help determine the factors that will be assigned values on the WFPA worksheet and those that must be considered but will not be assigned values.

Leopold's first set of factors were decimating factors—those that kill animals directly but are not habitat factors. These factors include hunting, predation, starvation, parasites and disease, and accidents. The influence of decimating factors must be considered, but their possible effects on the population in question should be documented in the worksheet section for assumptions.

Leopold's second set of factors were welfare factors—those that affect both the reproductive and mortality rate of a wildlife population. Welfare factors include food, water, cover, and special requirements such as salt or minerals. We term these "habitat factors" in the WFPA analysis. One or more of these welfare factors will always be less than optimal or most favorable to the population.

Biologists will be familiar with the habitat factors that affect a given wildlife or fisheries population. The WFPA user should consider not only broad categories of factors such as food, water, and cover, but also more detailed factors within each of these categories. The Habitat Suitability Index (HSI) models of the U.S. Fish and Wildlife Service (Schamberger and Terrell 1982) are a good source of the kinds of habitat factors that affect populations. Examples of habitat factors for a few selected species are shown in Table 2-1.

In these examples, the factors are explicit and can be measured in the field from topographic maps or from aerial photos. Thus, they are suitable for precise statements of objectives that are found in HMPs and AMPs. Unfortunately, this level of information often does not exist. The magnitude and importance of a project will dictate the time and amount of detailed information required to properly evaluate changes in wildlife or fisheries productivity.

Percent of Optimum

WFPA is based on professional judgment of how comparable the existing habitat is to the optimum conditions under which a habitat could exist. The biologist assigns a percentage value that represents how similar the habitat is now to the optimum, and how similar it would be at a future time both with and without the project. WFPA requires that these percentage values be written down so that they can be used to calculate the effects an action might have on a population. Modern resource management is demanding more quantification of resource impacts and more critical thinking about the inferences BLM draws from data.

Often, inventory and monitoring data can provide enough information to allow us to readily assign values for the percentage of optimum habitat, particularly for the more common wildlife species such as big game and upland game birds. Such data provide information on range condition and trend, utilization of key plant species, browse condition, location of water, and other factors. After years of experience in an area, biologists may already know approximate optimum habitat conditions for the species and area in question.

Information on optimum conditions may also come from other wildlife agencies, BLM biologists in other districts, BLM technical notes, other technical publications, books, HSI models, or specialists in

Table 2-1. Examples of habitat factors.

Species	Category	Habitat Factor/Specific Habitat Measurement
Pronghorn	Winter food quality	Percentage of shrub crown cover
		Mean height of shrub canopy
		Number of shrub species present
		Percentage of herbaceous canopy cover
		Percentage of available habitat in winter wheat
	Cover	Mean topographic diversity
	Other	Presence of net wire fences
		Water spacing
Gray Partridge	Winter food	Percentage of area in cropland
		Percentage of cropland in grain
		Percentage of cropland subject to fall/winter tillage
	Reproductive habitat	Percentage of area in idle land
		Distribution of idle land
		Percentage of herbaceous canopy cover
		Percentage of herbaceous canopy consisting of grass
		Percentage of area in pasture/hayland
Cutthroat Trout	Year-round habitat	Mean maximum water temperature
		Mean minimum water temperature during embryo development
		Mean minimum dissolved oxygen
		Mean water velocity over spawning areas
		Percentage of cover during late growing season
		Percentage of pools during low water period
		Annual minimum or maximum pH
		Percentage of stream shaded between 10:00 a.m. and 2:00 p.m.
Pileated Woodpecker	Year-round habitat	Percentage of tree canopy closure
		Number of trees > 20 in (51 cm) dbh (diameter breast height)/0.99 ac (0.4 ha)
		Number of tree stumps > 1 ft (0.3 m) in height and > 7 in (18 cm) in diameter per 0.5 ac (0.2 ha)
		Number of snags > 15 in (38 cm) dbh/0.5 ac (0.2 ha)

universities. Whatever the source, good professional judgment is required by the user. Once these values are out in the open, productive criticism may improve the particular analysis and enhance understanding of the population factors in question.

Optimum Population Level

Optimum population level is the average population level or density of a species in a given area when all habitat factors are at optimum. Stated another way, this is the maximum attainable carrying capacity for a site, given the inherent limitations of the landscape, soils, vegetation, and other abiotic and biotic features.

For example, Leopold (1933:52-53) suggested that a density limit of about one bird per acre exists for bobwhite quail throughout its range. Thus, an area encompassing 20,000 acres of bobwhite habitat would have a predicted optimum population level of 20,000 birds. Similarly, Bull and Meslow (1977) noted that pileated woodpeckers need 300 acres of habitat in optimum condition to support one breeding pair. Therefore, a forest covering 6,000 acres could support an optimum population of 20 breeding pairs of pileated woodpeckers. Because data or literature to support such estimates may not exist, it may be necessary to extrapolate them from various types of information.

This number should reflect a biological optimum and should not be confused with the goal of a program or proposed action. The biological optimum represents the ideal condition, whereas a program goal represents a realistically attainable condition, given the limits of budgets, laws, conflicting uses, and the current condition of the habitat.

Limiting Factors

One of the fundamental concepts in WFPA is that of the limiting factors. Leopold (1933:39) stated that this concept is essential to understanding the ecological basis for game management. Odum (1959:93) wrote:

> "The presence and success of an organism or a group of organisms depends upon a complex of conditions. Any condition which approaches or exceeds the limits of tolerance is said to be a limiting condition or a limiting factor."

In evaluating projects and other proposed actions, BLM biologists have always considered limiting factors, at least implicitly. Common examples are brood-rearing habitat limiting a sage grouse population, winter browse limiting a mule deer population, spawning substrate limiting a trout population, and water availability limiting a bighorn sheep population.

WFPA is set up so that limiting factors are determined at the same time as optimum factors. After values are assigned for each habitat factor as a percentage of optimum, the limiting factor will emerge as the habitat factor with the lowest value. Limiting factors are identified for three conditions: now, with the proposed action, and without the proposed action.

The limiting factor may differ with and without the proposed action. For example, if water limits a bighorn population, water availability will not change without an action such as water development. Once optimum water development is attained, however, some other factor such as forage may become a limiting factor. At that point, further water development does not increase bighorn sheep population levels or productivity.

Some factors will change over time regardless of whether an action is implemented. For example, after a wildfire in shrub-steppe habitat, the winter forage value for the wintering mule deer will likely increase steadily for 20 years or more. Thus, this factor will change from a value of near zero to something higher, independent of other actions.

Once the habitat factors are listed, the analysis completed, and the limiting factor determined, the WFPA worksheet serves as a reference for that species in that particular area. If 2 years later another project is proposed in the same area, the analysis can be reviewed to determine the current limiting factor. If the data and assumptions still seem accurate, the new project can be analyzed from that point. Thus, you can accumulate a series of worksheets that build on one another.

Allowable Harvest Rate

The allowable harvest rate (AHR) is the percentage of a wildlife population that can be removed or harvested without depressing the population below the habitat's current carrying capacity. AHR is a biological determination that needs to be estimated regardless of whether the species will actually be harvested at that rate, or even harvested at all.

For example, we may want to analyze a project to improve habitat for mule deer. We know that 20 percent of the deer herd could be harvested annually without depressing the herd. Although only 10 percent of the herd is now harvested because of restrictive hunting regulations, the allowable harvest rate is still 20 percent because that is a biological determination.

AHRs are generally known for most big game and many upland small game species but must be adjusted to reflect specific local conditions. AHRs for other species can be estimated from information on a few critical population characteristics, such as recruitment rates and natural mortality rates.

Procedures - The WFPA Limiting Factors Worksheet

Productivity analysis is first documented on the limiting factors worksheet (Figure 2-3). A brief discussion of the entries needed for proper documentation and analysis follows.

Background information on the name of the project, size of area, location of area, and species being analyzed is documented at the beginning of the worksheet. To simplify cross-referencing and filing, use the same name for the proposed action as the name that appears on the Environmental Assessment (EA), HMP, AMP, RMP, Job Documentation Report (JDR), or Resource Improvement Project System (RIPS). You can evaluate several actions on one sheet, but when multiple worksheets are needed, use some system of subtitling the individual actions to maintain a coherent package.

On the form, describe the geographic area under consideration or refer to maps in an allotment or an Integrated Habitat Inventory and Classification System (IHICS) file. In most cases, a map can be attached to the WFPA worksheet unless it represents unneeded and time-consuming duplication. Spatial limits are always somewhat arbitrary, but the project site or management area must contain or affect the limiting factor(s). Thus, the area of analysis must be large enough so as not to exclude some biologically relevant factor. For example, say the proposed action is a prescribed burn followed by a grass-forb seeding in the Two Mesa Allotment. The project will improve early spring forage for a migratory mule deer herd returning from winter range. If the area of analysis is limited to the Two Mesa Allotment, then one might decide the project will increase the deer population. But if the limiting factor for this herd is actually the quality of winter browse 40 miles to the south, then the analysis would be erroneous. In the above example, the entire range of that herd in the area of analysis should be included to ensure that the limiting factor is not overlooked and to allow the cumulative effects on this herd to be tracked and analyzed over time. The above discussion probably illustrates the case for most wildlife populations. But if the proposed action affects a population that is more or less uniformly distributed and resident year-round, such as the gray partridge, the area of analysis may have to be arbitrarily defined.

Include a description of the location of the project or the area encompassed by the proposed action, using any of the three location options (Figure 2-3). The legal description uses the standard legal descriptors (i.e., township, range, section, etc.). However, the Universal Transverse Mercator (UTM) may be more compatible with Geographic Information Systems (GIS) and Land Information Systems (LIS).

In most cases, selecting a priority species or group would involve a simple statement of the species to be analyzed. If a migratory herd or flock is the subject, then reference the herd unit or use another description. Don't necessarily restrict yourself to a single species. You may want to consider groups of ecologically similar species, such as diving ducks or warm-water fishes. Prepare a separate worksheet for each species or group of related species.

Proposed Action Analysis (Part A)

The habitat factor/impact matrix in part A of the worksheet is designed to help you begin organizing your thought process. Consider each general habitat factor to determine which might be critical to the species or group in question and if the proposed action will affect the factor. If you find one or more factors to be critical, then you must make a judgment on the direction of the effects of the proposed action, putting a check in the plus (+) column for a positive effect, or in the minus (-) column for a negative effect. For each habitat factor, place a check in the appropriate column. If there are no checks in the negative (-) or positive (+) columns, the analysis is complete and you need not proceed to part B.

Habitat Factors - Limiting Factor Analysis (Part B)

In part B of the WFPA worksheet (Figure 2-3), define in as much detail as possible the habitat factors potentially affecting the population in question. A literature review will help to specify the habitat factors. Write in the factors on the blank lines under the appropriate general category. Some categories may not have entries for a given analysis, and not all lines within a category need to be filled. Consider only the factors that bear on the analysis. However, just because a factor will not change does not mean it shouldn't be considered. A factor, such as topography, that is limiting the population, may be beyond management control but it should be noted. Any factor that is at less than optimum may play a role.

Next, assign each of these factors a current habitat value as a percentage of the optimum. If possible, base these values on local data. If no local data exists and new data cannot be collected, use estimates based on the literature and professional judgment. Again, be sure to document the source of these values so they can be tracked and replaced by better data, should you obtain it.

Be sure that the numbers entered are as precise as possible, but don't enter numbers that suggest unwarranted precision. For example, don't enter 63 percent if you really don't know whether it's 50 percent or 90 percent. If you estimate the factor to be somewhere between 50 and 90 percent, then the midpoint of this range, 70 percent, is the best number to use.

After assigning these values, estimate the values that would exist with and without the proposed action in place. If you are analyzing more than one project or other management action on a single sheet, consider possible interactions. For example, a seeding by itself may cause an improvement in the forage factor for pronghorn. But, if a seeding is accompanied by a water development, the forage factor may actually decrease due to increased livestock use in the area. After entering all three columns of values, locate the lowest value in each column. These are the limiting factor values to be entered on lines B7(a), (b), and (c). The same factor may be limiting in all three cases, the factors may all be different, or some other combination may exist. In any case, the completed analysis should make sense from a biological viewpoint.

In most analyses, certain relevant items will be assumed to be true but not specifically captured in the analysis. Document these assumptions in an attachment to the worksheet. For example, a common assumption will be that other nonhabitat factors affecting the population, such as predation, will be the same with or without the proposed action.

Evaluate all proposed actions in this way unless you have a better model. For example, you might prefer several sophisticated models now in use for anadromous fish populations. HSI models have also been designed for many aquatic and terrestrial vertebrates and are easily obtained. If an alternative model is used, attach the analysis to the WFPA worksheet, but don't fill out part B of the worksheet as long as estimates of numbers are provided by the alternative analysis. Headings, assumptions, and sources of information must still be provided.

Complete the "Sources of Information" line for both part A and part B. Be as complete as possible, including references to in-house data files, vegetation maps, technical publications, phone conversations, and professional judgment. Append to the worksheet as much of this information as appropriate. Then, if the analysis is questioned or needs to be reviewed in relation to newly proposed actions in later years, all the needed information can be tracked.

Calculations (Parts C-H)

Enter the estimated optimum population level on line C of the WFPA worksheet (Figure 2-3). In column (a) of matrix D, enter the products of line B7(a), (b), and (c) (the limiting factors) times C (the optimum population level) as appearing in column A. Round off to the nearest whole number. These numbers then represent the estimates of current and future population levels with and without the project. If the current population level is known and this estimate differs greatly from the known level, readjust either estimate of optimum population level or the estimate of the percent of optimum. Similarly, if the estimated population levels with and without the project seem intuitively inaccurate, reevaluate the optimum habitat estimates. This step provides an opportunity to check all values for accuracy. For example, you may know the current population level and have a good estimate of the optimum level. By working backward from optimum level to current level, you can obtain the value of the limiting factor in B7(a). Again, all values should make biological sense.

If harvest predictions are required, enter the percentage of the population that can be harvested in column (b) of matrix D. Enter this value as a decimal (e.g., 25 percent should be entered as 0.25). In many cases, the same number can be used all three times (current, with action, without action). Then multiply these numbers by the population levels as shown in column (a) to obtain the predicted harvest levels in column (c).

On line E, enter the number of years after completion of the project until a change in population is fully realized. For example, if a burning will increase deer populations within 5 years, enter the number 5. Similarly, if a population is declining or increasing from degradation of habitat or succession, then enter the number of years before this change is completed. For example, if a deer population is expected to decline for the next 10 years due to loss of browse species from disease, enter the number 10.

Similarly, on line F, enter the number of years of population change in the herd without the proposed action.

Calculate the change in population and harvest as shown and enter the amounts on lines G and H.

Upon completing the WFPA worksheet, sign the bottom of page 2 and ensure that all needed attachments, references, and other documentation are complete. The analysis must then be reviewed by a wildlife or fisheries biologist for concurrence.

Place signed copies of the WFPA package as appendices or attachments to EAs, AMPs, and HMPs, and file them in allotment files, project files, or other files where appropriate. If the WFPA worksheet is completed for a benefit-cost analysis, then attach copies to the Hunter/User Day worksheet (discussed in the next chapter) as part of the benefit-cost calculation record. Area or district biologists should maintain copies of all analyses. These analyses will build on each other and share information. Because so many species and management actions are interdependent within a district, the analyses will inevitably have to mesh. Maintaining complete, accurate records is important. Throughout the analysis, this documentation should improve the understanding and management of wildlife and fisheries.

Discussion

Although the worksheet represents a systematic and quantitative approach to habitat evaluations, the calculations discussed above are based on a simplified view of biological processes. For example, this procedure assumes that a change in canopy coverage of sagebrush from 50 to 60 percent of optimum will have the same effect on a sage grouse population as a change in water availability from 50 to 60 percent of optimum. It also assumes that a change from 50 to 60 percent of optimum for some factor will have the same effect as a change from 10 to 20 percent of another factor. These calculations also provide no mechanism, outside of judgment, to account for interaction between habitat factors. In other words, the model is based on linear and independent operation of each factor. More complex models are available for some species and they can be used if the biologist has confidence in them. This approach is recommended because it is simple and straightforward and uses information and judgment which is readily available to BLM biologists.

Examples

The examples of wildlife/fisheries productivity analyses which follow show the WFPA procedure for pronghorn and sage grouse numbers for one proposed action—the Lava Park burn. Each example consists of a completed worksheet, a map, a list of assumptions for the selected species, and a step-by-step explanation of each entry on the worksheet. The circled numbers on the worksheets refer to the explanations that follow. In an actual analysis, many of the explanations would be listed as assumptions. Explanations are not listed that way here to avoid repetition.

Proposed Action ____________________

Area of Analysis ____________________

Location: Legal Description ____________________
or UTM Coordinates ____________________
or Latilong ____________________

Priority Species (Group) ____________________

A. Proposed Action Analysis

Habitat Factors	Impact from Proposed Action: Negative (-)	None (0)	Positive (+)
Food			
Water			
Cover			
Space			
Reproductive			

Sources of Information ____________________

B. Habitat Factors - Limiting Factor Analysis

	Habitat Rating (% of Optimum): Current	Without Action	With Action
1. Food			
______	______	______	______
______	______	______	______
______	______	______	______
2. Water			
______	______	______	______
______	______	______	______
3. Cover			
______	______	______	______
______	______	______	______
4. Space			
______	______	______	______
______	______	______	______
5. Reproductive			
______	______	______	______
______	______	______	______
6. Other			
______	______	______	______
7. Limiting Factor (smallest in column)	(a) ______	(b) ______	(c) ______

Sources of Information ____________________

____

Figure 2-3. Wildlife/Fisheries Productivity Analysis (WFPA) Limiting Factors Worksheet

C. Optimum Population Level: ______________________________

D. Population and Harvest Analysis

	Population	x	Percent of Population That Can Be Harvested	=	Harvest
1. Current	(a)__________ (B7a X C)	x	(b)__________	=	(c)__________
2. Without Action	(a)__________ (B7b X C)	x	(b)__________	=	(c)__________
3. With Action	(a)__________ (B7c X C)	x	(b)__________	=	(c)__________

E. Number of Years After Completion of Action to Realize Change in Population. ______________________

F. Number of Years Without Action to Realize Change in Population. ______________________

G. Change in Population Due to Action (D3a - D2a). ______________________

H. Change in Harvest Due to Action (D3c - D2c). ______________________

Prepared by ________________ Title ______________________ Date _____

Concurred by ________________ Title ______________________ Date _____

Figure 2-3. Wildlife/Fisheries Productivity Analysis (WFPA) Limiting Factors Worksheet (Continued).

Background

Lava Park is a kipuka—a 7,000-acre island of vegetation surrounded by unvegetated lava flows. It lies at 5,200 feet elevation and is dominated by three-tip sagebrush and basin-big sagebrush. Together these species provide about 35 percent canopy coverage. Major grass species are Idaho fescue and western wheatgrass. The understory has a diverse array of perennial forbs and several other grass species.

The park supports a resident population of sage grouse and a wintering pronghorn herd as well as a variety of nongame species, including the ferruginous hawk, a candidate species for Federal listing under the Endangered Species Act. Domestic sheep briefly graze the area in early spring and late fall. Lava Park is also part of a four-pasture, rest-rotation system for cattle.

The area supervisory range conservationist has proposed a prescribed burn for the park. The burn would remove about 70 percent of the current canopy cover of sagebrush in a mosaic pattern and, if successful, would increase by 500 the number of AUMs for cattle. The project would cost about $1,100.

You have been asked to evaluate the possible impacts of the burn on sage grouse and pronghorn populations, and you have been reminded that earlier monitoring in this area shows that three-tip sagebrush sprouts vigorously following fire.

About 175 pronghorn winter in the park. Periodic winters with unusually deep snow can decimate the herd because of the lack of topographic cover. The herd summers on excellent range in a mountain valley north of Lava Park. Demand for pronghorn hunting is high and 25 percent of the available animals are taken annually.

About 120 sage grouse live year-round in the park. This population is far below historic numbers. Although cover in the park is excellent for nesting and wintering, there is a shortage of brood-rearing habitat. The current understory suggests that forb response to a prescribed burn would be excellent. Demand for hunting sage grouse in this area is low.

Ferruginous hawks nest in scattered junipers on lava flows that surround the park area. One pair is known to use the area for breeding and feeding. Because the project area contains dense sagebrush, the hawks spend most of their hunting time outside the proposed burn area.

Example l - Pronghorn (Figure 2-4)

Assumptions

- The burn will be incomplete, leaving about 30 percent or about 2,100 acres of the current habitat as is.
- Winter range factors are limiting.
- Conditions on summer range will remain the same.
- Winter snow conditions will be about average.
- The HSI Model for pronghorn is an accurate model for the area of analysis.

Explanations

(Numbers correspond to numbers circled in Figure 2-4.)

1. The proposed action is the Lava Park controlled burn, the same name that appears on the environmental assessment. This is the first of two worksheets for analyzing impacts on different species.

2. The area of analysis references a locally-known geographic area, an IHICS map, and a topographic map of the area.

3. A known pronghorn herd is the basis of the analysis.

4. In the proposed action analysis, food/forage and cover/space are listed as the critical factors. The proposed action will benefit food/forage but not affect cover/space.

5. Because a limiting factor analysis follows, the references are listed below.

6. The HSI model for pronghorn was used to assess this prescribed burn, and habitat factors are named and evaluated according to that publication. The first factor is percent shrub crown cover. Note that the date on this factor was taken from the resource area's Breeding Bird Transects Monitoring File. The HSI model gives a decimal value of 0.8 for the current rating and 0.3 for the rating with the proposed action. Without the action, the rating will increase to 0.9 or 90 percent of optimum.

7. With the project, average height of shrub canopy would decline from optimum, or from 1.0 to 0.8. Without the project, no change would occur. Seedling sagebrush is not considered part of the canopy.

8. The percentage of herbaceous canopy cover would increase from 60 to 90 percent (0.6 to 0.9) with the proposed action. Without the action, this factor would decline to 50 percent (0.5).

9. The last habitat factor from the HSI model is mean topographic diversity. Although this factor will not change, it must be considered because it is less than optimum and may be the limiting factor.

10. The lowest value before the project is 0.6 for herbaceous canopy. Thus, the near-optimum shrub conditions cannot be fully used to optimize the population. The lowest value after the burn would be 0.3 shrub crown cover. If no action is taken, the lowest value will be 0.5.

11. The sources of information include the HSI model used to evaluate optimum conditions, the state game and fish department's pronghorn plan, and the resource area data file with vegetation information. Photocopies of the HSI graphs might be attached to aid any later discussion of the analysis.

12. The optimum population size (292) was calculated by dividing the known current population size (175) by the current limiting factor value (0.6). This number is consistent with the state's goal of maintaining a herd size of between 250 and 325 pronghorn.

13. The number for the current population (175) was obtained from an aerial census taken in the same year as the analysis.

14. The population size without the project is expected to decrease to 146. This number was obtained by multiplying the limiting factor value without the project (0.5) by the optimum population (292).

15. The population size with the project was obtained by multiplying the optimum population (292) by the limiting factor rating (0.3) with the project.

16. The state's pronghorn plan provides for harvesting 25 percent of the herd.

17. As a result of the prescribed burn, a loss of 58 pronghorn is projected. Because the limiting factor will be percentage of shrub crown cover, the effect is expected during the first winter following the burn.

18. The net result is a loss of 15 harvestable animals. This value is suitable for conversion to hunter days and economic analysis.

19. Because the analysis was prepared by the area biologist, the district biologist reviewed and concurred with it.

Proposed Action *Lava Park Controlled Burn* (1)

Area of Analysis *Lava Park* (2)

Location: Legal Description *T. 23 N., R. 15 W., Secs. 8 & 9*
or UTM Coordinates ______
or Latilong ______

Priority Species (Group) *Pronghorn* (3)

A. Proposed Action Analysis

Habitat Factors (4)

Habitat Factors	Impact from Proposed Action: Negative (-)	None (0)	Positive (+)
Food	(-)		
Water		0	
Cover	(-)		
Space		0	
Reproductive		0	

Sources of Information *See below* (5)

B. Habitat Factors - Limiting Factor Analysis (6)

	Habitat Rating (% of Optimum): Current	Without Action	With Action
1. Food (7)			
Shrub height	1.0	1.0	0.8
(8) *Herbaceous canopy cover*	0.6	0.5	0.9
2. Water			
3. Cover			
Shrub crown cover	0.8	0.9	0.3
(9) 4. Space			
Topographic diversity	0.8	0.8	0.8
5. Reproductive			
6. Other			
7. Limiting Factor (smallest in column) (10)	(a) 0.6	(b) 0.5	(c) 0.3

(11) Sources of Information *HSI Model: Pronghorns; F. & G. Pronghorn Mgt. Plan; BLM Breeding Bird Monitoring Transect Data*

Figure 2-4. Example of use of Wildlife/Fisheries Productivity Analysis (WFPA) Limiting Factors Worksheet for pronghorn.

C. **Optimum Population Level:** 292 (12)

D. **Population and Harvest Analysis**

	Population	x	Percent of Population That Can Be Harvested (16)	=	Harvest
1. Current	(a) 175 (13) (B7a X C)	x	(b) .25	=	(c) 44
2. Without Action	(a) 146 (14) (B7b X C)	x	(b) .25	=	(c) 37
3. With Action	(a) 88 (15) (B7c X C)	x	(b) .25	=	(c) 22

E. **Number of Years After Completion of Action to Realize Change in Population.** 3

F. **Number of Years Without Action to Realize Change in Population.** 3

G. **Change in Population Due to Action (D3a - D2a).** -58 (17)

H. **Change in Harvest Due to Action (D3c - D2c).** -15 (18)

Prepared by ____________ Title Area Biologist Date ________

Concurred by ____________ Title District Biologist Date ________

(19)

Figure 2-4. Example of use of Wildlife/Fisheries Productivity Analysis (WFPA) Limiting Factors Worksheet for pronghorn (Continued).

Example 2 - Sage Grouse (Figure 2-5)

Assumptions

- The burn will be incomplete, leaving about 30 percent or about 2,100 acres of the current habitat as is.
- Winter snow conditions will be about average.

  Shortage of brood-rearing habitat is now limiting the population.

- The frequency of succulent forbs in the habitat will increase to the same level as that found on the 1983 burn in Lava Park.
- Effects of possible cyclical population fluctuations will be considered.
- Sage grouse use Lava Park year-round.
- Harvest will continue at about 15 percent of the population.

Explanations

(Numbers below correspond to numbers circled in Figure 2-5.)

1. The proposed action is the Lava Park controlled burn, the same name that appears on the EA. This is the second of two worksheets for analyzing effects of the same project on different species.

2. The area of analysis references a locally known geographic area, an IHICS map, and a topographic map of the area.

3. The species of interest is sage grouse.

4. In the proposed action analysis, food/forage, water, and cover/space are listed as critical factors. The proposed action would affect each factor differently.

5. Because a limiting factor analysis follows, references will be included at the end.

6. The first factor, palatability of sagebrush species, will increase slightly (from 0.6 to 0.7) after the burn because of an increased frequency of seedling sagebrush. Without the project, this factor would remain the same.

7. Data from the prescribed burn monitoring study shows that the frequency of occurrence of succulent forbs should increase from 0.3 to 0.8. Without the action, this factor is not expected to change.

8. The availability of water over the summer and fall period will not change but may be limiting.

9. The canopy coverage of sagebrush is now at 0.9 and would decrease to 0.5 after the project. Without the burn, a change to optimum is expected.

10. The mean height of sagebrush canopy will decrease from 0.9 to 0.8 after the burn. Without the project, no change is expected. Seedling sagebrush are not considered part of the canopy.

11. Interspersion of herbaceous vegetation and sagebrush will improve from 0.6 to 0.8 with the action. A slight decrease to 0.5 is expected without the action.

12. The limiting factor both now and without the action is 0.3 for frequency of occurrence of succulent forbs. Although this factor will be greatly improved (to 0.8), the loss of sagebrush will cause canopy coverage to be the limiting factor at 0.5 with the proposed action.

13. References include sources for local vegetation measurement data, sage grouse population data, and sage grouse habitat requirements.

14. The optimum population for Lava Park was estimated from the state's sage grouse plan to be 400 birds.

15. The current population level (120) was not known, so it was calculated by multiplying the optimum level (400) by the current limiting factor rating (0.3).

Proposed Action Lava Park Controlled Burn (1)

Area of Analysis Lava Park (2)

Location: Legal Description T. 23 N., R. 15 W., Secs. 8 & 9
or UTM Coordinates ______
or Latilong ______

Priority Species (Group) Sage Grouse (3)

A. Proposed Action Analysis (4)

Habitat Factors	Impact from Proposed Action: Negative (-)	None (0)	Positive (+)
Food			+
Water		0	
Cover	(-)		
Space			
Reproductive			

Sources of Information See below (5)

B. Habitat Factors - Limiting Factor Analysis

		Habitat Rating (% of Optimum)		
		Current	Without Action	With Action
	1. Food			
(6)	Sagebrush spp. palatability	0.6	0.6	0.7
(7)	Succulent forbs (frequency)	0.3	0.3	0.8
	2. Water			
(8)	Summer / Fall	0.7	0.7	0.7
	3. Cover			
(9)	Sagebrush canopy	0.9	1.0	0.5
(10)	Sagebrush mean height	0.9	0.9	0.8
	4. Space			
	5. Reproductive			
(11)	6. Other Shrub / herbaceous vegetation interspersion	0.6	0.5	0.8
(12)	7. Limiting Factor (smallest in column)	(a) 0.3	(b) 0.3	(c) 0.5

(13) Sources of Information Sage grouse monitoring studies (BLM files); BLM Tech. Note for Sage grouse; F. & G. Mgmt. Plan for Sage grouse; Presc. Burn Studies

Figure 2-5. Example of use of Wildlife/Fisheries Productivity Analysis (WFPA) Limiting Factors Worksheet for sage grouse.

C. **Optimum Population Level:** 400 (14)

D. **Population and Harvest Analysis**

	Population	x	Percent of Population That Can Be Harvested	=	Harvest
1. Current	(a) 120 (15) (B7a X C)	x	(b) .15	=	(c) 18
2. Without Action	(a) 120 (B7b X C)	x	(b) .15	=	(c) 18
3. With Action	(a) 200 (B7c X C)	x	(b) .15	=	(c) 30

E. **Number of Years After Completion of Action to Realize Change in Population.** 3

F. **Number of Years Without Action to Realize Change in Population.** 3

G. **Change in Population Due to Action (D3a - D2a).** 80

H. **Change in Harvest Due to Action (D3c - D2c).** 12

Prepared by ____________ Title **Area Biologist** Date ______

Concurred by ____________ Title **District Biologist** Date ______

Figure 2-5. Example of use of Wildlife/Fisheries Productivity Analysis (WFPA) Limiting Factors Worksheet for sage grouse (Continued).

Chapter 3 - Wildlife Use

This chapter provides methods and data for estimating changes in recreational user days as a result of a proposed action. In the following chapter, estimates of user days are equated with dollar values for calculating benefit-cost estimates. In addition to describing calculations, this chapter also suggests sources of information and possible refinements in methods and data bases. The procedures use the results of the wildlife and fisheries productivity analysis (WFPA) described in Chapter 2. The methods and associated data bases can easily be automated so biologists preparing WFPA estimates need only enter those results into a computer program and select the options for calculation.

The theory of the user day calculations correlates population size with recreational use. For populations that are hunted or fished, use is correlated with the potential numbers that may be harvested. As with the WFPA, estimating changes from an action requires projecting changes through time—with and without the action. The difference between projected use with and without a proposed action is attributed to the action. The information base for estimating hunting and fishing is state fish and game agency harvest statistics.

Procedures for estimating changes in nonconsumptive use are also presented. The process uses information on nonconsumptive and consumptive use of Federal lands.

Relationship Between Wildlife Populations and Recreational Use

The methods developed for estimating use rely upon some implicit assumptions that everyone may not agree with. We believe the methods and assumptions are sufficiently realistic to provide BLM with useful estimates of the effect of changes in fish and wildlife populations on recreational use of the public lands. The basic assumptions behind the methods are:

- If wildlife populations change in size, human use will change because use of wildlife depends on the size of the wildlife population.
- Change in human use will be linear and proportional to current use rates per unit of animal population or harvest.
- Because a particular set of BLM allotments may provide only part of an animal population's total habitat, a change in human use is credited to a resource treatment independent of where the use actually takes place.

Wildlife attracts hunters, anglers, and viewers. The availability of wildlife for human use is strongly influenced by its numbers. Any change in population or in harvestable population can affect numbers seen and hunter and angler success rates. Many studies have shown a strong relationship between efforts devoted to hunting and fishing and wildlife availability or success rates.

A few studies have looked at the relationship between wildlife availability and viewing, photography, and other forms of nonconsumptive use. Changes in game and nongame populations affect numbers of encounters or sightings, which have been shown to be important in wildlife viewing, photography, and similar activities. Some nonconsumptive use is tied directly to hunting. For example, Kay (1988) estimates nonconsumptive use by nonhunting members of sheep hunters' parties. Similarly, Shaw and Mangun (1984) found substantial amounts of wildlife viewing by hunters during the off season.

Procedures and Considerations (User Day Worksheet)

Procedures to estimate changes in recreational use are shown in Figure 3-1. This may be done by calculating user days per animal harvested (UD/HARV) or user days per unit of animal population (UD/POP). Parts I and II of Figure 3-1 present two procedures for estimating the effects of habitat improvements on use of wildlife by hunters, anglers, viewers, and others. Part I requires estimating the number of hunter or angler days per animal harvested (UD/HARV). A hunter or angler day is considered to be any part of a day that a person spends pursuing a particular species. Part II requires estimating the number of user days per animal in the population (UD/POP).

Generally UD/HARV is the procedure used because the data on user days and animals harvested may be obtained from state fish and wildlife agencies and is usually more reliable than their population estimates. For this reason, running the analysis with both harvest data and population data may yield inconsistent results.

Step-by-Step Instructions - Part I: UD/HARV Procedure

Fill in the top part of the form on proposed action, species, and area as before. Enter the historical average number of user days that the wildlife species in the area or region supports on line 1. To reduce the distortion of unusual weather or other hunting conditions, use an average of at least 4 years. The geographic area should be no smaller than the affected animals' entire habitat and preferably should encompass a larger area because a larger area may be more representative of hunting pressure. Data sources include the following:

- Each state's department of wildlife and fisheries resources
- U.S. Fish and Wildlife Service national surveys
- Agency (BLM, U.S. Forest Service) planning documents

Use the historical average number of wildlife harvested in the area or region for line 2. The historical average should be based on the same time period as the hunter days in line 1, and the geographic area should be the same as that used in line 1. Units of measure for fish harvests, either numbers or weight, should correspond to those used in the WFPA worksheet. Data sources should include those discussed for hunter/fisher days. If you cannot obtain harvest surveys, estimate harvest using your knowledge of the area or literature that discusses what proportion of a species population is harvested annually. On line 3, divide line 1 by line 2 to get user days per harvest. On line 4, insert the predicted change in harvest from line H of the WFPA worksheet. On line 5, multiply line 3 by line 4 to obtain the change in user days as a result of the proposed action.

Step-by-Step Instructions - Part II: UD/POP Procedure

Do not use this procedure unless the wildlife species is not hunted or fished, or there is no available harvest data. Determine the annual user days on line 1 as previously described, then skip to line 6 of part II. Enter the number of animals in the region on line 6. Use the same base year and region for the population estimate as you used for hunter days on line 1. Units of measure for fish harvests, either numbers or weight, should correspond to those used in the WFPA worksheet. On line 7, divide line 1 by line 6 to obtain user days per unit of population. On line 8, enter the change in population predicted as a result of the proposed action from line G of the WFPA worksheet. On line 9, multiply line 7 by line 8 to obtain the predicted change in user days as a result of the proposed action. Data sources include those mentioned for the UD/HARV procedure.

Step-by-Step Instructions - Change in User Days Worksheet

An alternative worksheet (Figure 3-2) can be used with either UD/HARV or UD/POP ratios calculated on the worksheet in Figure 3-1, or with previously derived ratios. Use either part A if a UD/HARV ratio is known, or part B if a UD/POP ratio is available. Then simply fill in the harvest or population data from the WFPA worksheet, the UD/HARV, or UD/POP ratio, and multiply each line to obtain user days with and without the project. You now have the basic data necessary to do the benefit-cost analysis described in Chapter 4.

Geographic Limits

You will need to consider whether to use user ratios for a state, district or smaller area. The user ratio should be calculated for an area no smaller than a BLM administrative area. The BLM district might be an appropriate limit in some cases. In reality, the value of a hunter/fisher day should be higher where success rates are higher. Because a uniform, statewide value is assigned to a hunter/fisher day, you

Proposed Action ______________________________

Species ____________________ **Area** ____________________

Part I: UD/HARV Procedure.
This is the preferred procedure for species which are used in hunting and fishing.

1. Average annual hunter days currently estimated ____________
2. Average annual harvest currently estimated. ____________
3. Divide line 1 by line 2. This is UD/HARV (or insert value for area). ____________
4. Change in harvest projected with project. (Line H from WFPA worksheet) ____________
5. Multiply line 3 by line 4. This is a change in user days projected with project. ____________

Part II: UD/POP Procedure.
Use this procedure for species which are not used in hunting and fishing or for which harvest data are not available.

6. Average annual population of animals currently estimated. ____________
7. Divide line 1 by line 6. This is UD/POP (or insert value for area). ____________
8. Change in population projected with project. (Line G from WFPA worksheet) ____________
9. Multiply line 7 by line 8. This is a change in user days projected with project. ____________

Prepared by:____________ Title:____________ Date:________

Concurred By:____________ Title:____________ Date:________

Figure 3-1. User Day Worksheet

Proposed Action ____________________

Species ____________________ **Area** ____________________

A. UD/HARV Procedure

	Harvest[1]	x	**UD/HARV**[2]	=	**User Days**	**Year**[3]
Base level	______ D.1.(c)		______ line 3		______	______
Without Action	______ D.2.(c)		______ line 3		______	______ (F.)
With Action	______ D.3.(c)		______ line 3		______	______ (E.)

B. UD/POP Procedure

	Population	x	**UD/POP**	=	**User Days**	**Year**[3]
Base level	______ D.1.(a)		______ line 7		______	______
Without Action	______ D.2.(a)		______ line 7		______	______ (F.)
With Action	______ D.3.(a)		______ line 7		______	______ (E.)

---

[1] References in first column are to matrix D of WFPA Limiting Factors Worksheet.
[2] References in second column are line numbers in User Day Worksheet (Figure 3-1.)
[3] References for years are to WFPA Limiting Factors Worksheet.

Prepared By: ____________________ Title: ____________________ Date: __________

Figure 3-2. Change in User Day Worksheet.

should use uniform hunter/fisher success ratios for a given species within a BLM district or area so that the value of an additional animal in the population will be the same throughout the district or area.

Dealing with Trends and Fluctuations

The data used to calculate UD/HARV or UD/POP ratios should be as reliable as possible because spurious data will produce spurious predictions of changes in use. If the year-to-year data are known to fluctuate widely, the basic data must cover enough years to average out fluctuations. If you detect trends in the use ratios and believe they will persist, you may use the trends to project use ratios for both the with and without use levels.

General Considerations

The virtues of the user day procedures are that they are simple and inexpensive to use and they give order-of-magnitude accuracy. More sophisticated and potentially more accurate methods could be developed for projecting use, but these methods are also more costly to develop and use. If you choose to use a more costly method, fully justify it.

UD/HARV and UD/POP ratios for restricted hunts, such as trophy only or limited drawings, may be unusually small and thereby lead to low wildlife value estimates. Typically these hunts have low-use, high-success rates, and higher than average values per hunter (Stiles 1983). Using the low UD/HARV ratios typical of these hunts in conjunction with average values per hunter day may seriously under-estimate additional wildlife values. For special situations where limited trophy hunting is practiced, other approaches such as suggested by Kay (1988) may be more appropriate.

Nonconsumptive Use - Considerations and Calculations

Wildlife viewing, photography, feeding, and other nonconsumptive uses can be deliberate or incidental. An example of deliberate nonconsumptive use is travelling to a remote Nevada mountain to see bighorn sheep. A good example of incidental wildlife viewing takes place on Colorado River boat trips through Cataract Canyon where boaters often see bighorn sheep. The viewing of bighorn sheep is incidental to the trip, but nearly all who see them get added pleasure from the experience. Although there is evidence that seeing wildlife incidentally heightens the pleasure of trips in the backcountry, we will not attempt to quantify such incidental value here. Instead, we will address the value associated with deliberate or primary nonconsumptive use of wildlife on BLM land.

General Considerations

Surveys have consistently shown that wildlife numbers and diversity are primary determinants of user satisfaction. Other important but immeasurable factors include the aesthetic character of the surroundings and weather. Both demand and the availability of wildlife determine which species are involved with nonconsumptive use. Species most valued include songbirds, squirrels and chipmunks, waterfowl, rabbits and hares, deer, birds of prey, and butterflies. Mammals and birds are the leading categories in attracting primary nonconsumptive use visits. Among the large mammals, deer are most important, but no more popular than small mammals like squirrels, chipmunks, rabbits, and hares. Kellert and Berry (1980) found that generally the most preferred wildlife are those that people consider aesthetically appealing, intelligent, or those that are culturally and historically significant.

Nonconsumptive and consumptive use of BLM lands has been estimated by apportioning the total nonconsumptive public land use in the western states between the U.S. Forest Service and BLM lands in proportion to the total recreation visits reported by these agencies in each state (Connelly and Brown 1988). Primary nonconsumptive use of BLM land in the western states in 1985 was about 2.4 million days annually (Table 3-1).

Among the major public domain states, the range is from 896,000 days in California to 29,000 days in Montana. How does this compare with consumptive use on BLM lands? We do not have comparable data for all types of hunting on BLM lands, but we do have data on deer, elk, small game, waterfowl, and other game hunted on BLM lands. We can also estimate the ratio of nonconsumptive to consumptive

Table 3-1. Primary nonconsumptive use of BLM lands.

State	Visits	User-Days
AK	23,002	73,372
AZ	154,509	368,327
CA	620,269	896,051
CO	145,785	191,814
ID	206,678	291,012
MT	19,799	29,357
NV	58,666	101,882
NM	48,182	68,974
ND	338	376
OR	139,644	183,150
UT	81,370	108,018
WY	25,487	47,656
Total	1,523,729	2,359,989

Source: Connelly and Brown (1988)

Table 3-2. Nonconsumptive and consumptive recreational use of Federal lands (in 1000 user days).

State	Consumptive Use	Nonconsumptive Use	Ratio
AK	367.20	203.20	0.55
AZ	1,815.20	659.02	0.36
CA	2,973.90	1,628.35	0.55
CO	1,234.30	438.90	0.36
ID	1,496.40	151.72	0.10
MT	1,144.80	199.21	0.17
NV	525.40	151.55	0.29
NM	580.80	171.74	0.30
ND	369.80	41.85	0.11
OR	2,032.20	429.55	0.21
UT	1,392.40	259.75	0.19
WY	1,022.70	212.99	0.21

Source: U.S. Department of the Interior and U.S. Department of Commerce (1982)

use of all Federal lands in the western states. Table 3-2 shows the user days by state for both consumptive and nonconsumptive use for all Federal lands.

Note that Alaska, Arizona, California, and Colorado show more than 35 percent as much nonconsumptive as consumptive use, while Idaho, Montana, North Dakota, and Utah show less than 20 percent.

Nonconsumptive use is a major wildlife use and statistics are detailed enough to determine how much nonconsumptive use is taking place on public lands in different states. Because information is sketchy on the populations of many nongame species which are sought out for nonconsumptive use, and we have nothing like harvest information to base use ratios on, techniques for projecting nonconsumptive use cannot be as direct as techniques for projecting consumptive use. However, evidence from available statistics and literature leads to the following conclusions: Wildlife viewing on the public domain lands, while it does not generate as much volume of use as hunting and fishing, is too important to ignore, and the availability of game and nongame species affects nonconsumptive use.

The procedure described in the next section projects primary nonconsumptive use from projections of hunting use by using the ratios of nonconsumptive to consumptive use reported in Table 3-2. Each analyst will need to decide in particular cases whether nonconsumptive use can be quantified for the benefit-cost analysis or whether it is best to wait and consider the value of nonconsumptive use when considering non-quantitative factors (Chapter 5).

Nonconsumptive/Consumptive Calculations

This procedure assumes that both nonconsumptive and consumptive use change to the same degree in response to changes in wildlife populations. For example, if all hunting was projected to double with the project, nonconsumptive uses would also be expected to double. If hunting was projected to decrease by 50 percent, nonconsumptive use would likewise decrease by 50 percent. Using the statewide ratio of nonconsumptive to consumptive use, the procedure calculates an estimate of nonconsumptive use with and without the proposed action. The worksheet designed to implement the nonconsumptive/consumptive procedures is shown as Figure 3-3.

①	②		
WILDLIFE SPECIES	CONSUMPTIVE WILDLIFE USE		
	EXISTING	WITHOUT	WITH
	(user days)	(user days)	(user days)

③ TOTAL CONS USE ______ = ______ = ______

④ NONCONS/CONS RATIO x ______ x ______ x ______

= = =

⑤ NONCONS USE [ ] [ ] [ ]

NONCONS/CONS CALCULATION (from Table 3-2)

Average annual days of consumptive use in the region ______

Average annual days of nonconsumptive use in the region ______

NONCONS/CONS RATIO = [ ]

Figure 3-3. Nonconsumptive Use Worksheet

Step-by-Step Instructions - Nonconsumptive Use Worksheet

Explanations

(Numbers correspond to numbers circled in Figure 3.3.)

1. List affected game species which were analyzed in the user day worksheets.

2. Obtain existing user day estimates for hunting/fishing from the user day worksheet.

3. Total the consumptive user days for each column from part 2.

4. Obtain the nonconsumptive/consumptive ratio from the noncons/cons table (Table 3-2). Use the same ratio for the existing, with, and without column unless a good case can be made from trend information for a change in the ratio over time. If you do not use the same figure, explain why a trend is adopted (i.e., why you think one type of use is increasing relative to the other).

5. Derive nonconsumptive use projections by multiplying the total consumptive use in row 3 by the noncons/cons ratio in line 4 for each column (existing, with, and without).

Critics may object that changes in the populations of game species are not the primary determinants of changes in nonconsumptive use as is assumed in this procedure. The procedure also assumes that desired nongame species will experience changes in population in the same direction as the projected changes in the game species. Both assumptions are warranted, within limits, but the analyst will have to decide whether the agreement is strong enough to justify use of the procedure in a particular case.

Examples

Examples of the user day calculations using the Lava Park Controlled Burn scenario are shown in Figures 3-4, 3-5, 3-6, and 3-7. Figures 3-4 and 3-5 are completed using the pronghorn as the priority species. Figures 3-6 and 3-7 are completed using the sage grouse as the priority species for comparison.

Proposed Action Controlled Burn

Species Pronghorn Area Lava Park

Part I: UD/HARV Procedure.
This is the preferred procedure for species which are used in hunting and fishing.

1.	Average annual hunter days currently estimated	1,148
2.	Average annual harvest currently estimated.	341
3.	Divide line 1 by line 2. This is UD/HARV (or insert value for area).	3.37
4.	Change in harvest projected with project. (Line H from WFPA worksheet)	12
5.	Multiply line 3 by line 4. This is a change in user days projected with project.	40

Part II: UD/POP Procedure.
Use this procedure for species which are not used in hunting and fishing or for which harvest data are not available.

6.	Average annual population of animals currently estimated.	1,564
7.	Divide line 1 by line 6. This is UD/POP (or insert value for area).	0.73
8.	Change in population projected with project. (Line G from WFPA worksheet)	80
9.	Multiply line 7 by line 8. This is a change in user days projected with project.	58

Prepared by:__________ Title: Area Biologist Date:__________

Concurred By:__________ Title: District Biologist Date:__________

Figure 3-4. Example of use of User Day Worksheet for pronghorn.

Proposed Action: Controlled Burn

Species: Pronghorn Area: Lava Park

A. UD/HARV Procedure

	Harvest[1]	x UD/HARV[2]	= User Days	Year[3]
Base level	44	2	88	
	D.1.(c)	line 3		
Without Action	37	2	74	3
	D.2.(c)	line 3		(F.)
With Action	22	2	44	3
	D.3.(c)	line 3		(E.)

B. UD/POP Procedure

	Population	x UD/POP	= User Days	Year[3]
Base level				
	D.1.(a)	line 7		
Without Action				
	D.2.(a)	line 7		(F.)
With Action				
	D.3.(a)	line 7		(E.)

[1] References in first column are to matrix D of WFPA Limiting Factors Worksheet.
[2] References in second column are line numbers in User Day Worksheet (Figure 3-1.)
[3] References for years are to WFPA Limiting Factors Worksheet.

Prepared By: ____________ Title: Area Biologist Date: ________

Figure 3-5. Example of use of Change in User Day Worksheet for pronghorn.

Proposed Action *Controlled Burn*

Species *Sage Grouse* Area *Lava Park*

Part I: UD/HARV Procedure.
This is the preferred procedure for species which are used in hunting and fishing.

1.	Average annual hunter days currently estimated	598
2.	Average annual harvest currently estimated.	150
3.	Divide line 1 by line 2. This is UD/HARV (or insert value for area).	3.98
4.	Change in harvest projected with project. (Line H from WFPA worksheet)	12
5.	Multiply line 3 by line 4. This is a change in user days projected with project.	48

Part II: UD/POP Procedure.
Use this procedure for species which are not used in hunting and fishing or for which harvest data are not available.

6.	Average annual population of animals currently estimated.	
7.	Divide line 1 by line 6. This is UD/POP (or insert value for area).	
8.	Change in population projected with project. (Line G from WFPA worksheet)	
9.	Multiply line 7 by line 8. This is a change in user days projected with project.	

Prepared by:__________ Title: **Area Biologist** Date:__________

Concurred By:__________ Title: **District Biologist** Date:__________

Figure 3-6. Example of use of User Day Worksheet for sage grouse.

Proposed Action: Controlled Burn

Species: Sage Grouse Area: Lava Park

A. UD/HARV Procedure

	Harvest[1]	x	UD/HARV[2]	=	User Days	Year[3]
Base level	18		0.9		16.2	
	D.1.(c)		line 3			
Without Action	18		0.9		16.2	3
	D.2.(c)		line 3			(F.)
With Action	30		0.9		27.0	3
	D.3.(c)		line 3			(E.)

B. UD/POP Procedure

	Population	x	UD/POP	=	User Days	Year[3]
Base level						
	D.1.(a)		line 7			
Without Action						
	D.2.(a)		line 7			(F.)
With Action						
	D.3.(a)		line 7			(E.)

---

[1] References in first column are to matrix D of WFPA Limiting Factors Worksheet.
[2] References in second column are line numbers in User Day Worksheet (Figure 3-1.)
[3] References for years are to WFPA Limiting Factors Worksheet.

Prepared By: ____________ Title: **Area Biologist** Date: ________

Figure 3-7. Example of use of Change in User Day Worksheet for sage grouse.

Chapter 4 - Benefit-Cost Analysis

This chapter discusses the steps required to complete the benefit-cost analysis. This chapter also introduces IAM, the BLM computer program for doing economic analyses (USDI, Bureau of Land Management 1985). At this stage, the background calculations for benefit-cost analysis have been accomplished using the procedures in Chapters 2 and 3. The biologist has estimated the biological effects of the proposed management actions and translated these effects into changes in recreational use. Now the gains in recreational use must be compared to the costs of producing them. Benefit-cost or investment analysis may be foreign to biologists, but it is a required BLM procedure, and in most BLM offices a biologist must see that it is done. The BLM Habitat Management Plan Manual requires an evaluation of the costs and returns of habitat improvement projects.

The acceptable standards and procedures for economic analysis of habitat improvement projects are published in Chapter 6, Section 3, of *Renewable Resource Improvement and Treatment Guidelines and Procedures* (BLM Handbook H-1740-1). This chapter will discuss and apply those standards.

The result of the analysis will be either the B/C or the cost-effectiveness ratio. The cost-effectiveness ratio is a special case of benefit-cost analysis to be used when costs and not benefits can be measured, and the project is meeting a common goal such as increasing production of bighorn sheep.

General Considerations

Units and Scope of Analysis

Generally, an activity plan constitutes the unit for fish and wildlife program investment analysis, but an activity plan may consist of components which are independent or stand-alone parts of the plan. If the independent parts of a plan are not optimized, the plan will not be optimal. The reason for separate analysis of the parts is to assure that they are sound investments. Investment analysis of the plan as a whole can be conducted by accumulating the results of the separate analyses. IAM has an option that will accumulate the benefits and costs of a series of separate projects.

A separable part is a convenient unit for analysis when an HMP covers a number of allotments and species. A part is not separable if its total effectiveness depends on completion of other parts of the HMP. A habitat improvement project is any separable part of an HMP, or other activity plan, that achieves a particular fish or wildlife objective. The benefits and costs of the separable projects that constitute an HMP can be accumulated for the benefit-cost analysis of the HMP as a whole. (An extended discussion of the subject of separability is found in Appendix II.)

Where habitat improvement is a separable part of an AMP, and is to be funded from a wildlife subactivity, it may be analyzed separately to aid in allocating fish and wildlife funds. It is important also that the AMP as a whole be evaluated with impacts on wildlife as a part of the analysis. The extent of the economic analysis performed, in any case, should depend upon the importance and magnitude of the decisions being made.

Costs

As with benefits, you need to compare costs with and without the project. Costs without the project are normally zero if BLM has no improvements to maintain on a particular allotment. IAM accommodates fairly detailed cost information. Costs with the project will include construction or installation costs spread over a maximum of 5 years. If the project is expected to take more than 5 years to complete, consider breaking it into segments that can be completed within separate 5-year periods. You will also need to know annual maintenance costs and the year in which maintenance will start.

The expected life of each installed component and its replacement cost are relevant if the period of analysis is longer or shorter than the life of the project. The standard period of analysis in IAM is 50 years, which is far longer than most BLM treatments or improvements will last. Therefore, replacement costs will need to be entered at the end of the useful life of each component.

Replacement costs cannot exceed installation costs due to inflation because all prices are to be in constant dollars, not inflated dollars, but may be different for engineering reasons. If the project has a cooperator, you will need to know the percentage of construction and maintenance costs that are BLM's responsibility and those that are the cooperator's responsibility. You will also need to know cooperator workdays and BLM workdays for project installation and for annual maintenance and monitoring. BLM state offices will provide estimates of the unit costs of cooperator and BLM labor, or districts may have their own price schedules built into the IAM program. The best source of cost data is from records of recent construction or from files on past activity plans.

Reliable cost data can be as important as good estimates on the benefits of the project. If the data is older than a year, it must be adjusted to current construction cost levels. IAM cost tables come with preprinted lines for standard items such as fences, springs, pipelines, seeding, and burning. State and district offices will possess the cost information for these features. Blank lines are also provided for other components to be written in the IAM tables.

If obtaining current cost estimates for any item is a problem, field office allotment files, JDR files, and RIPS files may be good places to look. Usually staff engineers know current cost levels or can apply construction cost indexes to bring old data up to current levels. Because costs are estimated in constant dollars, projected inflation factors do not need to be applied to projected cost levels. However, a cost inflation factor may have to be applied if a construction cost item is inflating more rapidly than the general price level.

The guiding rule in determining costs is that a cost is anything of value that is consumed for the project. The cost of the thing is its market price or, lacking a price, its value in some other use. The value of a sack of concrete or length of pipe is no mystery if it has been purchased. But suppose the pipe is surplus. Then its value is based on its other possible uses, or on whether anyone else wants it. If it will not be used for another purpose, its cost will be zero. (Further discussion of cost analysis is found in Appendix II.)

Benefits

Just as you must know "with and without" project costs, you must also know "with and without" project benefits. At this point in the procedure, you know recreation benefits in user days, but these units are not useful in a full benefit-cost analysis unless converted to dollar values. Ordinarily, converting to dollar values is not a problem for IAM users because these values are supplied in the form of a computer price file maintained for each state. Each district may have its own price file if it chooses. If you are doing the analysis without IAM, it is still a good idea to use the state or district price file for consistency. (Appendix I includes a sample price file and contains tables of willingness-to-pay values for fishing, hunting, and nonconsumptive use taken from the *National Survey of Fishing and Hunting*.)

Because the analysis is covering a period of years, you will have to estimate the number of years required for benefits to reach projected levels. In the WFPA worksheet, we estimated the years required to effect changes in numbers. If you are using a spreadsheet for a discounted cash-flow analysis, you will need to decide whether the increase from year zero to the time when the full effect is realized is linear or follows some nonlinear path. IAM makes this easy by allowing four levels of benefits to be specified along with the year in which each is to be realized.

The limiting factors worksheet also requires an estimate of population and potential harvest levels without the project. The "without project" condition can be handled most simply by assuming that current populations and use rates will continue indefinitely. This assumption always deserves to be questioned. If information exists to support the judgment that total output without the project will change over time, that information should be used to project the "without project" condition.

Handling Benefits When There are No Prices

If the available price file has no prices for certain outputs, you can use costs from other sources. An example of this situation is if fur harvest is a product of a project, you can determine the prices of fur from current local market information. If you can't establish prices for a product, but the quantity of output can be estimated (i.e., user days, numbers of animals) and you are running the analysis for only one product, state the output in the units available. If you have specified costs of the project, the IAM analysis will treat each unit as a value of 1 and provide a discounted output-cost ratio. For example, if you want to compare different projects designed to increase bighorn populations and you can't put a dollar value on a bighorn, the IAM B/C will let you compare the number of bighorn produced per dollar for the alternative projects.

Use this approach only when just one product is involved. If the project has more than one product, the resulting ratio will be a garble of different units. This is why there is a need to express value of outputs in dollars so that different products can be summed. For example, if alternative projects would increase mule deer and sage grouse in different combinations of the two, the convenient way to compare the alternatives is to place separate dollar values on the mule deer and on the sage grouse.

Estimating Nonconsumptive Benefits

Traditionally, estimating the units and dollar values of nonconsumptive use has been a problem in BLM investment analysis. As discussed in Chapter 3, analysis of *The 1985 National Survey of Hunting and Fishing* provides use rates and values in each state for nonconsumptive use. If nonconsumptive use and values prove elusive, you may evaluate and discuss these factors in the ranking stage of the analysis where unmeasurable values are considered (discussion in Chapter 5).

Interest Rates

The discounted cash flow (DCF) analysis is the heart of the benefit-cost computation. The discounting involves applying an interest rate factor to benefits and costs realized in future years. The discount rate is the particular interest rate chosen for the DCF analysis. The question is: Which interest rate is correct for discounting future benefits and costs? Generally, a 4 percent rate is used by the U.S. Forest Service with the rationale that lower rates favor longer-term natural resource investments. A rate between 8 and 9 percent is used by the Water Resources Council, and a 10 percent rate is recommended by the Office of Management and Budget (OMB) based on the rationale that this is the cost of capital in the private sector and government investments should be competitive.

IAM runs the benefit-cost analysis at all three rates and allows you to compare the results. Usually the lowest interest rate will yield the highest B/C and the highest interest rate will yield the lowest ratio. Normally, the middle ground of the Water Resources Council rate, which has been between 8 and 9 percent in recent years, is preferred. The mysteries of the interest rate in the benefit-cost calculation are explored in Appendix II.

The Benefit-Cost Ratio and Other Results

The results of a benefit-cost analysis can be expressed as the B/C, the output-cost ratio, and the present net value. The B/C shows the discounted benefits per dollar of discounted cost. The output-cost ratio shows output in physical units per unit cost. Present net value is the total amount of discounted benefits less total discounted costs.

The internal rate of return expresses the economic yield of the project as a percentage rate of interest. The internal rate of return is the interest rate at which the project breaks even (B/C = 1.0 and present net value = 0). It is calculated by running the DCF analysis at different interest rates until the break-even rate is found. The internal rate of return is a useful way to look at the return on the rancher's investment. If the internal rate of return on the rancher's share of the investment is higher than his/her borrowing rate of interest, then the rancher is making money on his/her share of the project.

The B/C is the favorite criterion because of its intuitive simplicity. However, when choosing from many projects of varying sizes, always check both present net value and the B/C because the B/C does not reflect the size of the net gain. Because the goal of economic efficiency is to maximize present net value and because projects come in different sizes, you can be fooled by B/Cs into spending your budget on many smaller projects and neglecting a much larger project that is better. The larger project may have a lower B/C than the best of the small projects but possess a higher present net value than all the small projects taken together. If the budget can only build the large project or all the small ones, the larger project may be overlooked unless present net values are compared.

Benefit-cost, present net value, and internal rate of return are locked together in a mathematical relationship. Knowing any one of these three, we can know something about the other two. Table 4-1 compares the B/C with present net value and internal rate of return. In any particular case and for a given interest rate, a B/C of 1.0 is equivalent to a present net value of zero and an internal rate of return equal to the interest rate.

Table 4-1. The benefit-cost ratio and related criteria at a given interest (discount) rate.

Benefit-Cost Ratio	Present Net Value	Internal Rate of Return
B/C > 1.0	Positive	Greater than interest rate
B/C = 0	Zero	Equal to interest rate
B/C < 1.0	Negative	Less than interest rate

Benefit-Cost Analysis Using IAM

The BLM's IAM computer program performs benefit-cost calculations. The program consists of a series of steps for automating data, making calculations, and displaying the results. Results displayed include B/Cs, budgetary costs, and costs to all parties participating in the project. IAM operates on the "with and without" principle in that it requires the operator to establish costs and benefits with and without the project. Having developed this information, the work in IAM consists of entering it in the appropriate place. The PC version is easy to use because screens are presented for entering the data and the cursor moves from cell to cell. IAM performs the difficult work of making the economic calculations.

The with and without costs and output data are entered into the IAM program in a form resembling Figures 4-1 and 4-2. Data is typed in on the screen and outputs in physical units and costs in dollars must be specified for a 50-year period. You must do this for the existing situation (the "without" condition) and one or more alternative proposed actions (the "with" condition).

The types of cost information IAM requires are:

- structural
- nonstructural
- construction
- operation
- maintenance
- replacement
- BLM share
- management
- BLM workdays
- cooperator workdays.

IAM takes livestock forage benefits in AUMs and recreation benefits in hunter days, angler days, and recreation activity days, and converts them to dollar values using the information in the price file provided by each state or district office. IAM also needs to know the year in which benefits reach projected levels, information which is listed on the limiting factors and user day worksheets. If you cannot establish values for a benefit but output can be measured, enter the benefits in physical units. IAM will then assign the value of one dollar to the units of output and provide a discounted output/cost ratio.

IAM INVESTMENT ANALYSIS: PROGRAM COST DATA

Structural Projects	Unit	New Units	Construction Cost by Year 1	2	3	4	5	%BLM	Years to First Maint.	Annual Maint. Cost	%BLM	Replacement Life	Replacement Cost
0.3 Springs	No.												
0.4 Reservoirs	No.												
0.5 Wells	No.												
0.6 Pipelines	No.												
0.7 Fences	No.												
0.8 Cattleguards	No.												
0.9													
1.0													
1.1													

Nonstructural Projects	Unit	New Units	Construction Cost by Year 1	2	3	4	5	%BLM	Life Span	Replacement %BLM	Replacement Cost
1.2 Mech. Ctrl.	AC										
1.3 Chem. Ctrl.	AC										
1.4 Burning	AC										
1.5 Seeding	AC										
1.6											
1.7											
1.8											

Management Costs

	Initial	Annual
1.0 Cooperator or Volunteer Workdays:		
2.0 BLM Workdays:		

Figure 4-1. IAM Investment Analysis - Program Cost Data Worksheet

IAM INVESTMENT ANALYSIS: PROGRAM BENEFIT DATA

	Units	Base Level	First Level		Second Level		Third Level		Fourth Level	
			Units	Yr.	Units	Yr.	Units	Yr.	Units	Yr.
Livestock Forage										
2 1 Livestock	AUMs									
Recreation Use										
2 2 Hunting Days Deer	HDs									
2 3 Elk	HDs									
2 4 Antelope	HDs									
2 5 Other Big Game	HDs									
2 6 Waterfowl	HDs									
2 7 Upland & Small Game	HDs									
2 8 Angler Days Warm Water	ADs									
2 9 Cold Water	ADs									
3 0 Rec. Days Devlpd. Site	RDs									
3 1 Dispersed Use	RDs									
3 2 Non-Game Wildlife	RDs									
Other Outputs	Units									
3 3 Soil/Water Damage										
3 4										
3 5										
3 6										

3 7 ___ % of Livestock AUMs available between ___ (Mo. Day) and ___ (Mo. Day) at the Final Level (5)

Figure 4-2. IAM Investment Analysis: Program Benefit Data Worksheet

Benefit-Cost Analysis Without IAM

IAM is the standard BLM program for benefit-cost analysis. However, the availability of PCs and spreadsheet software allows the design of customized benefit-cost programs. Do not avoid the requirement of estimating costs and benefits using the "with" and "without" principles and state-of-the-art techniques such as those presented in this guide. Standard spreadsheet programs conduct DCF analyses from which net present value and B/Cs can be calculated. Some spreadsheets also analyze internal rates of return. However, the algorithm for calculating these values may vary slightly. One difference between IAM and a spreadsheet program is that the spreadsheet will expect data to be entered for each year of the analysis unless you can devise formulas to do this.

If software other than IAM is used to calculate the present value of benefits and costs, use a 50-year period of analysis and current BLM price files and interest rates. If exceptions are made, explain them.

Example

As with any good computer program, IAM provides a variety of products to show results in different degrees of detail and also permits tracking of program input data. An example of the different types of reports produced by IAM follows.

Summary Results

Figure 4-3 shows how IAM summarizes results. Block A contains the results of the investment analysis, the B/C, and the present net value. Note that the results are shown for BLM costs, and all costs, and that the B/Cs are different for "all costs" than for "BLM costs." This difference reflects the costs of the cooperator's workdays being subtracted from all costs to get BLM costs. The discounted values also show the discounted value of the costs as split between BLM and "others." Block B shows the internal rate of return on the basis of total costs, BLM costs, and others. This is the rate of interest earned on the funds spent on the project. Blocks C, D, and E summarize the undiscounted cost data. Block C, which shows the total undiscounted expenditures for the 50 years of analysis, is useful for calculating the cost per additional AUM, which is a rough measure of efficiency. Block D shows BLM's 5-year budget costs for the project. When cooperators are important participants in a project, Block E gives pertinent data on their initial and annual costs. Block F and the page header contain identifying information to help with filing and record keeping.

Project Benefits

Figure 4-4 shows how IAM summarizes project benefits or outputs. The output categories are listed in the same order as they were encountered on the input forms. The outputs are shown as base yield and sustained yield. The sustained yield, with and without the project, represents the values attained when outputs leveled off.

The summary of benefits includes a column on unit values (the prices) which are in the computer for use on projects in a particular state or district. The last column shows the results of multiplying the outputs for each year by unit values and discounting each yearly total to the present. In this case, note that the present value of the loss in antelope hunting outweighs the gain in sage grouse hunting, and the gain in livestock forage far exceeds the net loss in value of hunting. As the figure heading states, present values shown were calculated at the 8.875 percent interest rate.

Investment Costs

Figures 4-5 and 4-6 reproduce the IAM input tables. These are useful matters of record and also allow input data to be verified. Figure 4-5 shows "with project" data which IAM calls the "alternative program," and Figure 4-6 shows "without project data" which IAM calls "existing program." Block A contains the cost data and block B contains the benefit data. No discounting is shown in these tables because this is input data.

STATE: ID
DISTRICT: SHOSHONE — ALLOT NO: 1234 — PROGRAM INDENT: BASE
RESOURCE AREA: MONUMENT — ALLOT NAME: LAVA PARK — BASE YEAR: 1985

A

EFFICIENCY TEST RESULTS

EFFICIENCY RATIOS				DISCOUNTED VALUES			
DISCOUNT RATE	BENEFIT / ALL COST	BENEFIT / BLM COST	PRESENT NET VALUE (B-C)	TOTAL BENEFIT	COST TOTAL	COST BLM	COST OTHERS
4.000%	1.2 / 1	1.2 / 1	3426	25849	22423	21351	1072
8.875%	0.8 / 1	0.8 / 1	-3289	11571	14859	14249	610
10.000%	0.7 / 1	0.7 / 1	-4064	10001	14064	13508	556

B

INTERNAL RATE OF RETURN

TOTAL COST	BLM COST	OTHER COST
5.8%	6.4%	113.9%

C

50-YEAR UNDISCOUNTED EXPENDITURES

	BLM	OTHER	TOTAL
EXPENDITURES	44106	2332	46438
COST / ADD AUM	2.41	0.13	2.54

D

BLM BUDGET COSTS FOR FIRST FIVE YEARS

NEW FACILITIES & MANAGEMENT					EXISTING FACILITIES		
YEAR	CONST.	O & M	MGT.	TOTAL	O & M	REPLACEMENT	TOTAL COST
1	11000	0	864	11864	0	0	11864
2	0	0	108	108	0	0	108
3	0	0	108	108	0	0	108
4	0	0	108	108	0	0	108
5	0	0	108	108	0	0	108
TOTAL	11000	0	1296	12296	0	0	12296

E

------------COST TO OTHERS------------
CONSTRUCTION TOT. : 0

----AVERAGE ANNUAL COST----

OPER. & MAINTENANCE	0
ANNUALIZED REPLMT.	0
LIVESTOCK MGT.	0
TOTAL ANNUAL COST	47

F

DATA PREPARED BY

EXISTING PROGRAM		ALTERNATIVE PROGRAM	
XXXX	RANGE CON	XXXX	RANGE CON
RICH	WILD BIO.	RICH	WILD BIO.
MILTON	ECON.	MILTON	ECON.
DAVIS	ECON.	DAVIS	ECON.

NOTE : ROW COLUMN TOTALS MAY NOT SUM CORRECTLY DUE TO ROUNDING

Figure 4-3. Example of IAM output - Efficiency test results.

STATE: ID
DISTRICT: SHOSHONE — ALLOT NO: 1234 — PROGRAM INDENT: BASE
RESOURCE AREA: MONUMENT — ALLOT NAME: LAVA PARK — BASE YEAR: 1985

ANNUAL YIELD, UNIT VALUES, AND PRESENT VALUES (8.875%)						
OUTPUT CATEGORY	UNIT	BASE YIELD	SUSTAINED W/O	YIELD WITH	UNIT VALUES	PRESENT VALUE OF CHANGE
Livestk For. (Avg.)	AUM	778	740	1135	6.97	23803
Livestk For. (Seas.)	AUM	778	740	1135	6.97	0
Deer Hunting	HDS	0	0	0	26.22	0
Elk Hunting	HDS	0	0	0	35.18	0
Antelope Hunting	HDS	88	73	44	54.00	-15294
Other Big Game	HDS	0	0	0	36.00	0
Waterfowl Hunting	HDS	0	0	0	28.51	0
Upland & Small Game	HDS	16	16	27	28.50	3062
Warm Water Angling	ADS	0	0	0	14.07	0
Cold Water Angling	ADS	0	0	0	23.35	0
Developed Site Rec.	RDS	0	0	0	5.56	0
Dispersed Use Rec.	RDS	0	0	0	3.33	0
Nongame Wild. Riew.	RDS	0	0	0	21.11	0
Soil & Water	$'s	0	0	0	1.00	0

Figure 4-4. Example of IAM output - Annual yield, unit values, and present values

A

ALTERNATIVE PROGRAM COST DATA

STRUCTURAL PROJECTS		NEW CONSTRUCTION COST BY YEAR							MAINTENANCE				
		UNITS	1	2	3	4	5	% BLM	BEG YR	ANN COST	% BLM	REPLACEMENT LIFE	REPLACEMENT COST
Springs	0	NO	0	0	0	0	0	0	0	0	0	0	0
Reservoirs	0	NO	0	0	0	0	0	0	0	0	0	0	0
Wells	0	NO	0	0	0	0	0	0	0	0	0	0	0
Pipelines	0	MI	0	0	0	0	0	0	0	0	0	0	0
Fences	0	MI	0	0	0	0	0	0	0	0	0	0	0
Cat. Guards	0	MI	0	0	0	0	0	0	0	0	0	0	0

MANAGEMENT COSTS:	INITIAL		ANNUAL	
Cooperator	4 Days - $	176	1 Day - $	44
BLM	8 Days - $	864	1 Day - $	108

B

ALTERNATIVE PROGRAM BENEFIT DATA

ANNUAL OUTPUTS	BASE LEVEL	FIRST UNITS	LEVEL YR	SECOND UNITS	LEVEL YR	THIRD UNITS	LEVEL YR	FOUTH UNITS	LEVEL YR
Livestock (AUMs)	778	1135	3	0	0	0	0	0	0
Deer (HDs)	0	0	0	0	0	0	0	0	0
Elk (HDs)	0	0	0	0	0	0	0	0	0
Antelope (HDs)	88	443	0	0	0	0	0	0	0
Oth. Big Game (HDs)	0	0	0	0	0	0	0	0	0
Waterfowl (HDs)	0	0	0	0	0	0	0	0	0
Upland & Small Game	16	27	3	0	0	0	0	0	0
Warm Water (ADs)	0	0	0	0	0	0	0	0	0
Cold Water (ADs)	0	0	0	0	0	0	0	0	0
Devlpd Site (RDs)	0	0	0	0	0	0	0	0	0
Disperse Use (RDs)	0	0	0	0	0	0	0	0	0
Nongame Wldf (RDs)	0	0	0	0	0	0	0	0	0
Soil and Water ($)	0	0	0	0	0	0	0	0	0

0% of Livestock AUMs are available between 0 / 0 at the final level.

Figure 4-5. Example of IAM output - Alternative program cost data and alternative program benefit data.

STATE: ID
DISTRICT: SHOSHONE — ALLOT NO: 1234 — PROGRAM INDENT: BASE
RESOURCE AREA: MONUMENT — ALLOT NAME: LAVA PARK — BASE YEAR: 1985

EXISTING PROGRAM COST DATA

STRUCTURAL PROJECTS	UNITS		TOTAL	ANNUAL	MAINT. COST
Springs	0	NO	$	0	0% BLM
Reservoirs	0	NO	$	0	0% BLM
Wells	0	NO	$	0	0% BLM
Pipelines	0	MI	$	0	0% BLM
Fences	0	MI	$	0	0% BLM
Cattleguards	0	MI	$	0	0% BLM

NONSTRUCTURAL PROJECTS		NUMBER OF UNITS BY AGE GROUP 1-5	6-10	11-15	16-20	+25	LIFE SPAN (YRS)	TOTAL REPLACEMENT COST	% BLM
Mech. Ctrl.	AC	0	0	0	0	0	0	$ 0	0
Chem. Ctrl.	AC	0	0	0	0	0	0	$ 0	0
Burning	AC	0	0	0	0	0	0	$ 0	0
Seeding	AC	0	0	0	0	0	0	$ 0	0

EXISTING PROGRAM BENEFIT DATA

ANNUAL OUTPUTS	BASE LEVEL	FIRST UNITS	LEVEL YR	SECOND UNITS	LEVEL YR	THIRD UNITS	LEVEL YR	FOUTH UNITS	LEVEL YR
Livestock (AUMs)	778	740	20	0	0	0	0	0	0
Deer (HDs)	0	0	0	0	0	0	0	0	0
Elk (HDs)	0	0	0	0	0	0	0	0	0
Antelope (HDs)	88	733	0	0	0	0	0	0	0
Oth. Big Game (HDs)	0	0	0	0	0	0	0	0	0
Waterfowl (HDs)	0	0	0	0	0	0	0	0	0
Upland & Small Game	16	0	0	0	0	0	0	0	0
Warm Water (ADs)	0	0	0	0	0	0	0	0	0
Cold Water (ADs)	0	0	0	0	0	0	0	0	0
Devlpd Site (RDs)	0	0	0	0	0	0	0	0	0
Disperse Use (RDs)	0	0	0	0	0	0	0	0	0
Nongame Wldf (RDs)	0	0	0	0	0	0	0	0	0
Soil and Water ($)	0	0	0	0	0	0	0	0	0

0% of Livestock AUMs are available between 0 / 0 & 0 /0 at the final level.

Figure 4-6. Example of IAM output - Existing program cost data and existing program benefit data.

Chapter 5 - Strategies for Ranking Choices

This chapter presents criteria and procedures for establishing priorities for habitat investments in annual work plans. In Chapter 4, we identified benefit-cost criteria (B/C, present net value, and internal rate of return) to be used to compare alternatives in dollars and cents, possibly raising the concern that all benefits and costs that could not be given a monetary value would be ignored. In this chapter, we broaden the criteria to consider choices that cannot readily be given a dollar value. This chapter describes how to use the results of a benefit-cost analysis together with other criteria to rank choices.

General Considerations

Three Variations on the Benefit-Cost Ratio

In Chapter 4, we showed that IAM produces three benefit-cost results: the B/C, present net value, and internal rate of return. We settled upon the B/C as the most serviceable of the three criteria for our purposes. There are three variants of the B/C, each of which may be used as the criterion for ranking projects, depending upon the degree to which benefits can be measured in dollars and cents and whether costs or benefits are fixed or variable. These forms, as illustrated in Figure 5-1, are:

- **Benefit-cost** - where costs and benefits are measured in dollars and cents and both benefits and costs can vary. The measure is benefits per dollar of cost, and the goal is to maximize benefits per dollar of cost. Figure 5-1A illus trates this form by showing a range of B/Cs.

- **Output per unit cost** - where costs are measurable and one output is identifiable, but not measurable, in dollars and cents. The measure is output per dollar of cost, and the goal is to maximize output per dollar of cost. Output per unit cost is shown in Figure 5-1B.

- **Cost per unit output** - where goals may or may not be measurable in dollars and cents, but can be set so that costs of achieving the fixed goal can be compared. The measure is cost per unit output, and the goal is to minimize costs per unit. This idea is shown in Figure 5-1C where all plans achieve a performance goal like maintenance of a critical population of plants, but plan A is clearly the least-cost plan.

Each of these ratios provides a measurable economic factor for use with other factors in ranking and selecting projects. We will show how a worksheet can be used with one of these ratios and other factors for ranking projects and allocating budgets.

The B/C is a quantitative measure of a project's worth. Other factors may be qualitative, but both kinds may be used as ranking factors. The idea behind the use of ranking factors is to place projects in order of their worth so the best ones can be developed first. The ranking of a project will depend upon the values of the ranking criteria and the weight or importance assigned to each criterion.

Annual Operating and Out-Year Construction Costs

Although B/Cs include both initial and annual project costs, the annual costs of operating a project are a consideration because of the importance of anticipating costs in out-year budgeting. As explained in Chapter 4, IAM will print the first 5 years of construction costs so that if a project is not finished in the year it began, later construction and operating costs can be accounted for. Availability of out-year funds would be a consideration in ranking an investment.

Outside Funding or Cooperators

Availability of other funds and sources of cooperation can be a ranking factor. HMPs are one of the kinds of actions to be analyzed and ranked. It is BLM's policy that habitat improvement projects in HMPs being developed in cooperation with a state agency under Sikes Act authority have funding priority over projects for other HMPs, unless they yield an unacceptably low B/C and the state director sets them aside for one reason or another. Projects

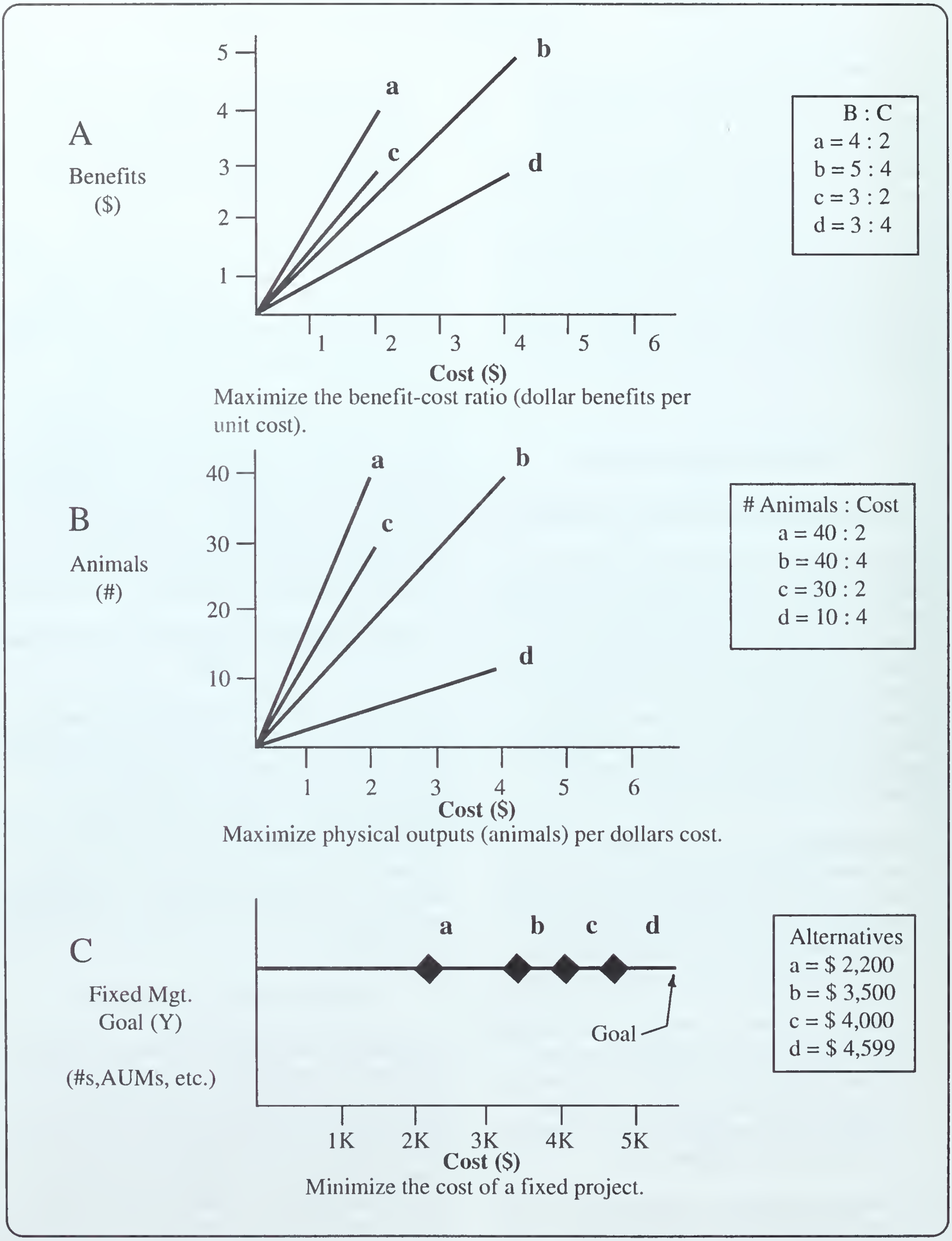

Figure 5-1. Three variations on the benefit-cost ratio.

with other sources of outside funding may also be given a favorable ranking for this reason unless they yield an unacceptably low B/C.

A B/C is judged unacceptable by comparing it with such ratios from other projects that could be funded. In a strict world, any B/C below a cutoff point of 1.0 would be unacceptable because at 1.0 there is no net present value, and there are usually other expenditures with higher B/Cs. In the Water Resource Council guidelines, a B/C below 1.0 is generally unacceptable but exceptions are allowable. BLM projects, however, are not subject to the Water Resource Council guidelines. Because BLM is directed to spend certain amounts of funds on particular types of range improvements, it may not always be able to show an arithmetical B/C greater than 1.0. In such cases, nonmonetary or intangible factors may legitimize the expenditure.

Use of Intangibles as Ranking Factors

Some factors which play a role in decisions are intangible in the same sense that some kinds of property are considered to be of intangible value, that is, not capable of easily being monetized. If benefit-cost analysis encompassed all relevant benefits and costs, decisionmaking would be rigorous and exact. Intangibles, however, can be incorporated in the analysis without loss of rigor if you are careful to avoid counting something twice—once in the monetary analysis and once in the analysis of all factors—and if you consistently apply weights or notions of importance to each factor. The following rule will avoid double counting: If, <u>and only if</u>, values represented by the following factors are not fully included in the monetary analysis may they be used as supplementary ranking criteria.

A proposed action will have intangible benefits if it:

- Conserves or protects Federal or state-listed, threatened, endangered, or sensitive species.

- Protects a wetland or riparian area that produces downstream or offsite benefits not included in direct use to hunters, anglers, and wildlife viewers.

- Protects or enhances crucial biological-use areas where importance cannot adequately be measured or where destruction would have irreversible, adverse consequences for an important species whose economic value may not be adequately reflected in the BLM price file (e.g., calving areas or strutting grounds for unique game animals).

- Protects or enhances the habitat of game or nongame species whose existence is highly valued by many people who have no intention of hunting, fishing, trapping, or viewing the individuals or populations at risk. (This factor is sometimes called existence value.)

When an action meets one or more of the above criteria (and is not totally accounted for in the monetary analysis), it may receive additional favorable consideration—that is the condition should be used as a positive ranking factor. If an opposite condition holds, such as risk to endangered species or damage to wetlands, it should be used as a negative ranking factor.

Ranking Procedures

Figure 5-2 shows a worksheet used to rank proposed habitat management projects. This worksheet is included in BLM Manual Handbook H-1740-1 (*Resource Improvements and Treatments Guidelines and Procedures*) as Appendix 2, and is similar to worksheets used for range improvement projects. District officers may want to devise a worksheet for ranking that incorporates elements from the wildlife and range worksheets and can be used for ranking both types of projects together.

Ranking projects is a necessary operation for deciding on the apportionment of limited funds among competing projects. Projects will be ranked in the resource area under the direction of the area manager or in the district under the direction of the district manager. The projects to be considered are those eligible under particular BLM funding codes. The eligibility test for each funding code is specified in BLM policy directives.

HABITAT PROJECT INVESTMENT RANKING WORKSHEET

HMP/AMP/PROJECT NAME	FY COST	ANNUAL MAINT	B/C	OUTSIDE FUNDING	T&E OR SENSITIVE	WETLAND/ RIPARIAN	CRUCIAL BIOL-USE	OTHER FACTORS	AREA MGR RANK	DIST MGR RANK

Figure 5-2. Habitat Project Investment Ranking Worksheet.

The first participants in the ranking process will be the resource specialists: biologists, soil and water specialists, foresters, range conservationists, and others. Their roles are to bring the technical information, judgments, and insights at their disposal to bear on the process. For example, the hydrologist will be consulted on the possible effects of a riparian project on stream flows, or a biologist will be consulted on the possible effects of a range improvement project on critical wildlife habitat. The goal at this stage in the process is to build consensus and determine areas of residual disagreement among resource specialists.

At the next stage in project ranking, the area manager or district manager is presented with the B/Cs, project investment costs, annual maintenance costs, and the statements on the noneconomic or intangible factors to be considered. If specialists disagree, the district or area manager may have to choose between conflicting assessments. But at this stage, specialists are not disagreeing about the rank to which the manager should assign a project, but about whether an environmental factor is relevant and would have a positive or negative impact. Specialists can have opinions about the ranking of projects for budget allocations and can appropriately express their opinions. Those opinions, however, should not color the results of a benefit-cost analysis, nor the technical judgments specialists make about the effects of projects on intangible factors.

The discussion of the ranking process would not be complete without mentioning the roles of public opinion, policy, and law. Public opinion influences ranking by such things as the existence value of certain wildlife populations. BLM policy and the laws under which BLM operates provide the guidance and goals under which a manager makes his or her project rankings. For example, it is policy that habitat management projects prepared under Sikes Act cooperative agreements will receive priority over non-Sikes Act projects, as long as B/Cs are in acceptable ranges.

The project ranking process cannot be described ,ompletely, nor can participants be instructed thoroughly in how it works. In the end, only practice and experience can develop the skills needed to perfect the ranking process. Consistent use of analytical techniques like limiting factor and benefit-cost analysis and ranking of projects based upon both monetary and intangible values should improve project ranking and ensure that public funds are well spent.

Example - The Lava Park Controlled Burn

The previous example in Chapter 4 displayed the results of the benefit-cost analysis of the Lava Park Controlled Burn. In ranking the project, both the economic analysis and other information was considered. Ranking is a misnomer in this instance because there is only one project to be discussed. However, the factors considered are discussed as though evaluating this project so that it might be compared and ranked with a number of other projects to which management would consider allocating habitat or range improvement funds.

Benefit-Cost Considerations

From the preceding chapter, we know that the Lava Park burn has a B/C of 0.8; it returns 80 cents in present value of benefits for each dollar in present value of costs. This is true at the interest rate of 8.875 percent—the only one of the three interest rates analyzed which will be considered. This result is neither good nor bad by itself. While the project returns less than its costs, this may be a better B/C than any other project being considered. Also, other factors need to be considered.

Look closely at the composition of a B/C. *The Resource Investment Analysis for the Rangeland Information System* (BLM User Handbook H-1743-1, 1992) displays the present value of the changes in outputs and the total of the discounted costs as follows:

Change in livestock forage	$23,803
Change in antelope hunting	-15,294
Change in small game hunting	3,062
Total discounted cost	$14,859

Two results are of interest here:

- Livestock forage benefits greatly exceed costs ($23,803/$14,859). In the absence of any evaluation of changes in the outputs of wildlife, the project would have a B/C of 1.6.

- There are losses in antelope hunting which are not offset by the gains in sage grouse hunting, so the total change in output of forage and wildlife is worth less than the costs of the project.

To evaluate the project more completely, we now turn to information beyond the benefit-cost analysis.

Other Considerations

This kipuka has a pair of ferruginous hawks nesting on its perimeter. The area biologist reports that the reduction in sagebrush crown cover will enhance both their prey base and hunting success. She estimates hawk production will probably increase by one bird per year and the ultimate result might be to get another breeding pair established on the kipuka. The ferruginous hawk is a candidate species for listing by the U.S. Fish and Wildlife Service under the Endangered Species Act. An increase in the hawk population is a desirable BLM goal and a plus for the project.

The increase in the sage grouse population may be of regional interest because state fish and game departments have expressed concern over a decline in regional sage grouse populations. The increase in sage grouse, therefore, may have value beyond its value for hunting. We can say it has existence value because of the regional concern for the population.

The analysis has ignored wildlife viewing. A dirt road open to the public traverses the kipuka. The removal of sagebrush cover will make antelope more visible even though there are fewer animals in the population. Other animals of interest will be more visible and the hawks and sage grouse will be more numerous. An increase in 15 or so wildlife viewing days at $21.11 per day would bring the B/C up to about 1.0. We would say the results may be sensitive to the addition of wildlife viewing benefits, and it may be that wildlife viewing should receive weight in the final ranking; however, if we have new information on wildlife viewing, we should repeat the benefit-cost analysis with the new information included.

No negative factors have been brought to light in staff discussions on the project.

Completing the Investment Ranking Worksheet

The ranking worksheet for the Lava Park Controlled Burn can now be completed as shown in Figure 5-3. The project name is inserted in column 1. The FY cost of $11,794, consisting of $11,000 for the cost of the burn and $794 as the BLM management costs, is inserted in column 2. Annual maintenance will cost one day of staff time in the field monitoring the area so we choose to show it as “1 day” instead of a monetary cost. A B/C of 0.8 is inserted under the column headed “B/C.” There is no outside funding so a zero is inserted under “Outside Funding.” Because the project favors the ferruginous hawk, a plus sign (+) is inserted in the column for T&E species. The next two columns receive zeroes because there are no riparian or crucial biological use considerations. Two plus signs (+) are inserted under “Other Factors” to signify the existence value of the increase in sage grouse, and the positive but unquantified influence of the burn on wildlife viewing. The completed worksheet (Figure 5-3) is now ready for the area and/or district manager.

HABITAT PROJECT INVESTMENT RANKING WORKSHEET

HMP/AMP/PROJECT NAME	FY COST	ANNUAL MAINT	B/C	OUTSIDE FUNDING	T&E OR SENSITIVE	WETLAND/ RIPARIAN	CRUCIAL BIOL-USE	OTHER FACTORS	AREA MGR RANK	DIST MGR RANK
Lava Park Controlled Burn	$11,794	1 day	0.8	0	+	0	0	++		

Figure 5-3. Example of use of Habitat Project Investment Ranking Worksheet.

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Appendix I - A Guide to Finding and Using Economic Values of Wildlife

BLM's main use of the economic values of fish and wildlife is in investment analysis of activity plans and projects involving range improvement and habitat management.

The Role of Prices

The price that hunters, anglers, and wildlife viewers are willing to pay for a user day of wildlife recreation defines the economic value of fish and wildlife resources. Willingness-to-pay has been the standard measure of wildlife and outdoor recreation values in BLM since the release of the Final Rangeland Improvement Policy of 1982 (IM No. WO-83-27). Willingness-to-pay is the price one would pay for an item rather than do without it.

Each BLM state office maintains a list of prices of AUMs, fish and wildlife-oriented outdoor recreation days, general recreation days, and certain costs. This price file is the main source for fish and wildlife values used in the IAM computer program for benefit/cost analysis. With the advent of the IAM program for personal computers, district offices can now create their own price files. An example of a state price file is shown in Table AI-1.

Table AI-1. Idaho IAM price file (in 1985 dollars).

Item	Units 1/	Value
Livestock Forage (Aug.)	AUM	$ 6.97
Livestock Forage (Seasonal)	AUM	$ 6.97
Deer Hunting	HDs	$ 26.22
Elk Hunting	HDs	$ 35.18
Antelope Hunting	HDs	$ 54.00
Other Big Game Hunting	HDs	$ 36.00
Waterfowl Hunting	HDs	$ 28.51
Upland and Small Game Hunting	HDs	$ 28.50
Warm Water Angling	FDs	$ 14.07
Cold Water Angling	FDs	$ 23.35
Developed Site (Recreation)	RDs	$ 5.56
Dispersed Site Recreation	RDs	$ 3.33
Nonconsumptive Wildlife-Associated Recreation	RDs	$ 21.11
Management Workdays		
Cooperator	8-Hour Day	$ 44.00
BLM	8-Hour Day	$108.00

1/ Units

AUM	-	an animal unit month
HD	-	a day or part of a day spent hunting
FD	-	a day or part of a day spent fishing
RD	-	a day or part of a day spent recreating

Willingness-To-Pay Methods

Willingness-to-pay for wildlife is the only measure of value that is compatible with the market prices BLM uses for the other commodities produced on the public lands. Normally, prices reflecting willingness-to-pay are collected from active markets. Because markets for access to hunting and fishing are not active in most locations, economists have developed methods to simulate willingness-to-pay. The commonly accepted methods of simulation are the travel cost and contingent value techniques. These techniques are outlined here and discussed more fully in Loomis (1986).

Travel Cost

The travel-cost method derives economic value from the observation that the proportion of a population who hunt, fish, and view wildlife decreases as distance from the recreation site increases. A person's willingness-to-pay the costs of travel is the key to the travel cost method. The price that could be charged for access to recreation is derived from econometric analysis of the number of visitors traveling different distances. It is assumed that if one had to travel farther, the likelihood of continuing to visit a site would decrease to the level of those now traveling that increased distance.

A recent travel cost study in Idaho found a willingness-to-pay for deer hunting of $26 per day (in 1985 dollars). This amount compares with an average trip cost of $40 (in 1985 dollars) for deer hunters traveling an average of 105 miles. The estimate of willingness-to-pay does not greatly differ from average travel cost in this example, but it is not the same conceptually or empirically. The estimate of willingness-to-pay is an amount over and above current costs that hunters would be willing to pay for continued access to hunting.

Contingent Value

The contingent value method involves observing hunter and angler intentions in the face of higher prices that could be charged for access to their sport. Here is an example of the method as used on deer hunters in the U.S. Fish and Wildlife Services's *1985 National Survey of Fishing, Hunting, and Wildlife Associated Recreation*:

1. Hunters were asked to recall their share of costs per day of deer hunting in the previous season.

2. Hunters were then asked if they would continue deer hunting if their costs tripled.

   a. A yes answer led to asking how many trips they would have taken at the tripled costs and then would they continue hunting if costs quadrupled.

   b. If the reply to the quadrupled costs was yes, they were asked how many trips they would have taken at the quadrupled costs and what was the most they would have paid (in 1985) per trip before they would not have gone deer hunting at all.

   c. If the hunters said no to paying tripled costs, they were asked if they would continue deer hunting if the costs doubled and if they said yes, they were asked how many trips they would have taken.

   d. A no answer at any subsequent point led to asking the hunters to name the cost per trip at which they would not have gone deer hunting in 1985.

The contingent value estimate from *The 1985 National Survey of Fishing, Hunting, and Wildlife Associated Recreation* for Idaho deer hunting is $33 per day (in 1985 dollars). This price is not statistically different from the $26 price in Table AI-1 that was estimated by the travel cost method. It is not unusual for the two methods to yield similar results.

Sources of Willingness-To-Pay Values

BLM has been using a variety of sources of willingness-to-pay values for hunting, fishing, and viewing. Some state offices, including Nevada, Colorado, Montana, and Idaho, have adopted results of state-sponsored studies using travel cost or contingent values. A memorandum from the Washington office to state offices in 1987 (Information Bulletin WO-87-118) advised the use of the best available willingness-to-pay studies in each state.

National Survey

The 1987 bulletin sanctioned use of the contingent value results in the 1980 and 1985 *National Surveys of Fishing, Hunting, and Wildlife Associated Recreation.* These values are provided in Table AI-2.

The 1980 survey included questions on trout, deer, and waterfowl. The 1985 survey included questions on deer, elk, waterfowl, bass, and primary nonconsumptive visits. Table AI-2 contains the 1980 value of trout fishing in each state (adjusted to 1985 prices) and the 1985 values for bass fishing, deer, elk, waterfowl hunting, and nonconsumptive use, all on a user day basis.

U.S. Forest Service RPA Values

Some state offices use U.S. Forest Service values for fish and wildlife-oriented recreation. At 5-year intervals, the U.S. Forest Service prepares a national analysis of projected demands for and supplies of the products of the national forests as required by the Forests and Rangelands Renewable Resources Planning Act of 1974 (RPA). The RPA values for 1985 were based on the best existing willingness-to-pay studies, but the results were subjected to some arbitrary adjustments which compromised their validity (if used in BLM, they should be multiplied by 1.6 to offset the arbitrary adjustment). The 1991 RPA values for wildlife have been released and are available.

U.S. Forest Service values are a problem for BLM because they are based on the arbitrary standard of a 12-hour activity day (Wildlife and Fisheries User Day). There is a misconception that the Office of Management and Budget imposes this standard 12-hour day, when all OMB requires is that recreational statistics be reported in visits and total hours. BLM uses the actual day an average outdoorsperson uses in each wildlife-related activity, whatever it happens to be (IM WO-87-118). For those who must use the RPA values, they can arbitrarily be cut in half to represent a 6-hour day which is close to average, or they can be corrected by the average hours per day spent in each activity. The 1980 and 1985 *National Survey* state reports contain the average hours per day in each wildlife-related activity. Average hours per user day for 1985 big-game hunting and trout fishing are reported in Table AI-3.

Table AI-2. Willingness-to-pay values in dollars for wildlife user days (1985).

	Hunting		Fishing		Nonconsumptive	
State	Deer	Elk	Waterfowl	Bass	Trout	
AK					27	30
AZ	39		25	17	14	39
CA	42		25	22	21	45
CO	37	40	23	13	17	32
ID	33	33	25	12	13	53
MT	25	30	23	7	16	22
NV	58		25	15	13	42
NM	49		23	24	18	41
ND	28		23	8	16	24
OR	30	27	25	8	16	33
UT	41	48	25	8	14	37
WY	37	48	23	20	18	40

Table AI-3. Average hours per day in big-game hunting and trout fishing.

State	Big Game Hunting	Trout Fishing
AZ	7.94	5.71
CA	6.82	6.36
CO	8.22	4.71
ID	7.61	5.12
MT	7.04	4.87
NV	7.40	5.58
NM	7.68	5.39
OR	6.91	5.56
UT	7.53	5.81
WY	7.74	5.01

Source: 1985 National Survey, State Reports

Use of the GNP Price Deflator

All prices for wildlife recreation used by BLM are adjusted to current price levels using the Gross National Product (GNP) Price Deflator for Total Consumer Expenditures. This index is maintained by the U.S. Department of Commerce, Bureau of Economic Analysis, and is published in the *Survey of Current Business*, which is received monthly by most local libraries.

To use the index to adjust the 1985 price up to the 1988 price levels, perform the following computation:

$$\frac{\text{1988 index value}}{\text{1985 index value}} \times \text{1985 price} = \text{1988 price}$$

Thus the adjusted value of deer hunting in Idaho in 1988, based upon a 1985 willingness-to-pay value of $33, would be $36.72 as shown below.

$$\frac{124.5}{111.9} \times \$33 = \$36.72$$

Existence Values

Price files do not contain the economic values of all the wildlife whose habitat BLM manages. Values in the price files are based on the uses of wildlife. Species that go largely unused are not included in the price files and cannot be included in a benefit-cost computation. If these animals have value, then it is existence value and should be considered when projects or activity plans are ranked for funding. When managers rank projects and make choices, they must consider habitat for these animals.

Appendix II - Technical Economic Issues

Certain difficult issues are bound to occur if a person works on investment analyses for a long enough time. The discussions in this section are designed to help the reader deal with some of the difficult issues. These include separability, some intricacies of cost analysis, and the mysteries of discounting.

The Analytical Problems of Separability and Sequencing

It is sometimes difficult to know when to analyze the HMP as a whole and when to analyze separate parts. When an economic analysis of proposed habitat improvements is conducted concurrently with preparation of an HMP, economic analysis of the parts will be an aid in setting attainable objectives and selecting the most efficient strategies to attain them. But an economic analysis may be desired for the HMP as a whole when the total plan is being presented. If the separate parts have been analyzed, then conducting an investment analysis for the entire plan is a matter of combining benefits and costs from the separate parts into one benefit-cost analysis. IAM will conduct cumulative analyses of separate projects.

An example will help one recognize a separable project. Suppose a fence, a watering device, and a reseeding are all part of a proposed habitat improvement. Together they are expected to increase the population by 50 animals. If separate analysis can show the following increases: fence-25 animals; water-15 animals; reseeding-10 animals, then the projects are separable because the yield of the separate features totals 50. If, on the other hand, analysis shows the following: fence-0 animals; water-5 animals; fence and water-40 animals, then the fence and water are not completely separable projects. The water may be productive as a separate project, but the water is more productive with the fence than without it. The fence has no productivity separate from the water and must be analyzed jointly with it.

In a productivity analysis of components in a system, a component's productivity may often depend upon the sequence in which the component is installed. To continue with the last example, installing the water first would increase the population by 5 animals, and building the fence next would add 35 animals, bringing the total increase to 40 animals. Reseeding last in the sequence might add 10 animals. If the sequence were reversed with the reseeding completed first, followed by the fence, and then the water, the value of the individual components might differ, but the total package would continue to produce 50 animals.

Incremental values are varying in these examples because components interact. Two of the three components may be the most efficient separable package that we can find, but we can only find out by analyzing the cases. The best advice is not to take questions of separability and sequencing for granted.

Intricacies of Cost Analysis

Costs are the things that have to be used to carry out an action; they are the consequences that have negative values. If in doubt about whether an item to be used in a project is a cost, ask if it has value to someone. If the answer is yes, it is a cost.

The following are some illustrations of the problems of what to include as costs and how to value them.

Items that have already been bought and paid for should not have their total cost charged to the project. A bulldozer, for example, could be costed on a project only for operating costs and wear and tear. The principle here is that only incremental costs count, but it is appropriate that some of the overhead costs, and certainly the appropriate share of the interest costs of the bulldozer be charged to the project if the financial officers insist.

Donations of material and labor should be included as the value to the donor. The costs of volunteer labor should include the volunteers' actual costs and a value for their time similar in principle to the value used in IAM for cooperator's time. Donated material should be charged at purchase price if the donor purchased it for the project. But if the material is surplus from the donor's stock, charge only salvage value, which may be zero. The principle here is that if the material (or labor) has some other use, it takes its value from that use; if it has no other use, it has no cost.

If land is devoted exclusively to the project and is removed from other uses, then the value of the land in the uses foregone is a cost of the project. By requiring a projection of outputs without the project, IAM incorporates the value of uses foregone in the analysis of the proposed action.

If the project has adverse consequences on some other resource, such as reducing the population of a species, those consequences are a cost of the project that might show up as a loss in benefits if the "without project" analysis is done correctly. Where BLM has rules for cost accounting, as in range improvement projects, the rules are to be followed on the principle that in cost accounting, consistency is everything.

Interest Rates and Discounting

The arithmetic of benefit-cost analysis looks complex because its calculations involve discounting future values. It may sound strange to conservationists to speak of discounting the future when conservation involves managing resources for the future. But we must also reckon with the present where a dollar in hand is worth more than a dollar next year or 10 years from now.

Table AII-1. Present and future values at different interest rates.

	$100.00 Compounded for 20 Years			Present Value of $100.00 Annuity	
Year (col. 1)	6 Percent (col. 2)	12 Percent (col. 3)		6 Percent (col. 4)	12 Percent (col. 5)
0	$100.00	$100.00	(Present Value)	$1146.99	$746.94
1	106.00	112.00		100.00	100.00
2	112.36	125.44		100.00	100.00
3	119.10	140.49		100.00	100.00
4	126.25	157.35		100.00	100.00
5	133.82	176.23		100.00	100.00
6	141.85	197.38		100.00	100.00
7	150.36	221.07		100.00	100.00
8	159.38	247.60		100.00	100.00
9	168.95	277.31		100.00	100.00
10	179.08	310.58		100.00	100.00
11	189.83	347.85		100.00	100.00
12	201.22	389.60		100.00	100.00
13	213.29	436.35		100.00	100.00
14	226.09	488.71		100.00	100.00
15	239.66	547.36		100.00	100.00
16	254.04	613.04		100.00	100.00
17	269.28	686.60		100.00	100.00
18	285.43	769.00		100.00	100.00
19	302.56	861.28		100.00	100.00
20	320.71	964.63		100.00	100.00

Money earns interest, which if allowed to compound will increase the amount in our savings account. Note in Table AII-1 that the first column shows a deposit of $100 in year zero, growing to $320 in year 20 at 6 percent interest compounded annually. Note also that the $100 deposit grows to twice its size in about 12 years. We could say that the future value of $100 at 6 percent for 20 years is $320.71. We could also say that the present value of $320.71 in year 20 at 6 percent is $100.

The arithmetic of benefit-cost analysis is concerned with stating correctly the present values of future events. Note that column 4 of Table AII-1 shows that at year zero, the amount of $1,146.99 would be the present value or DCF value of $100 paid every year for 20 years. Think of $100 as an annuity for 20 years. The amount required to be on deposit in year zero at 6 percent interest to provide an annuity of $100 for 20 years is $1,146.99. We could thus say that the present value of $100 for 20 years is $1,146.99 at 6 percent interest.

Present and future values are sensitive to the interest rate used in calculations. Notice column 3 which compounds $100 at 12 percent per annum. The $100 doubles in about 6 years, the new sum doubles in the next 6 years, and that new sum doubles in another 6 years, so that by about 18 years, the $100 deposit has grown eightfold. Contrast that growth with the growth of the same $100 deposit in column 2 at 6 percent interest over the same time period.

The DCF values at year zero in columns 4 and 5 (Table AII-1) show a similar story. A much smaller sum is needed at 12 percent to pay a $100 annuity than is needed at 6 percent. To our bankers, this phenomenon simply means that a smaller sum must be on deposit at the start of the annuity period at the higher interest rate because the balance remaining each year after the $100 payment is earning a higher return. Someone mainly concerned with the distant future can find a different meaning here: The higher interest rate means that future benefits are worth less to us today than if interest rates were lower. If the $100 received annually is called a future benefit, then its present value is far less at 12 percent than at 6 percent. If a policy requires postponing consumption now for future benefits, we can afford more provision for the future at lower interest rates than at higher ones. The mathematical truth of this is revealed in columns 4 and 5. We would only pay $746 in year zero for the same stream of benefits at 12 percent interest that would be worth $1,146 at 6 percent.

One way of better providing for the future is to postpone the costs of an action. Often we design a project to require a large initial investment in high technology which has low annual operating costs. The stream of costs might look like those in column 2 of Table AII-2. With a cost of $1,100 in year zero

Table AII-2. Cash flows totaling $1,300 showing present values at 8 percent interest.

Year	Cash Flow I	Cash Flow II
0 (Present Value)	1100.00	100.00
1	10.00	60.00
2	10.00	60.00
3	10.00	60.00
4	10.00	60.00
5	10.00	60.00
6	10.00	60.00
7	10.00	60.00
8	10.00	60.00
9	10.00	60.00
10	10.00	60.00
11	10.00	60.00
12	10.00	60.00
13	10.00	60.00
14	10.00	60.00
15	10.00	60.00
16	10.00	60.00
17	10.00	60.00
18	10.00	60.00
19	10.00	60.00
20	10.00	60.00
Total	1300.00	1300.00
Present Value (DCF) after 20 years	$1198.00	$689.09
Present Value (DCF) after 50 years	$1222.33	$834.01

and annual costs of $10 for 20 years, the present value (the DCF) of the cash flow is $1,198 at 8 percent interest. Now consider another type of cash flow as shown in column 3 with the same total outlay, but costing only $100 initially and $60 annually for maintenance and operation. The present value of this stream of costs is $689 at 8 percent interest, reflecting a substantial savings for postponing expenditures.

Usually the sponsors of projects like to extend the economic analysis of the project for 50 years or longer to be able to count more benefits. The bottom portion of Table AII-2 shows the effects on the DCF of extending the analysis from 20 years to 50 years. The extra 30 years of $10 per year adds $24 or 2 percent to the present value. The extra 30 years at $60 per year adds $145 or 21 percent to the present value.

With results so sensitive to the interest rate, or discount rate as it is often called, what is the correct rate to use? The easy solution, and the most correct one, is to use the formula adopted by the Water Resources Council in 1969 and enacted into law in the Water Resources Development Act of 1974. The formula is based on the average annual yield of government debt with 15 or more years to maturity. The formula also restricts the rate from changing by more than 0.25 percent per year. The first rate under the formula was 4.625 percent. It has increased without interruption each year since it was first applied in 1970 until 1987 when the rate stood at 8.875 percent.

Appendix III - Regional Economic Impact Analysis.

This appendix provides a basic introduction to regional economic impact assessment and of the procedures for measuring the economic impacts of wildlife-oriented recreation.

Economic Impact and Economic Value

As discussed in Chapter 1, impact assessment is but one aspect of wildlife economics and is not to be confused with investment analysis. BLM approaches the economic analysis of land use plans and environmental impacts and the economic analysis of resource improvements and treatments from different perspectives. On one hand, BLM's investment guidance (reflected in BLM Manual Handbook H-1740-1) emphasizes appraising the economic return on an investment, to whomever that return may accrue. On the other hand, BLM approaches impact assessment from the perspective of the economic interests of a region or area. The regional interests are concerned with returns that will be captured by the regional economy and with the costs that will be borne by the region. Assessing regional economic impacts requires data on the structure of regional economies and the expenditures and employment effects of a proposed action in a region. For that reason, the expenditures of outdoor sports enthusiasts and nonconsumptive wildlife users are important to a region. The differences between impact analysis (the subject of this appendix) and investment or efficiency analysis (the subject of Chapters 1-5 in this guide) are summarized in Table AIII-1. Biologists need to remember the distinctions and to know that they will be called upon to participate in efficiency analysis when investments are being evaluated and to participate in impact analysis when RMPs and EISs are being done. In both exercises, a limiting factors analysis will be performed as the first step, but the end results differ.

Table AIII-1. Comparison of regional economic impact analysis and investment (benefit-cost) analysis.

	Regional Economic Impact Analysis	Investment (Benefit-Cost Analysis)
Data required	Recreationists' expenditures	Market values of wildlife-oriented recreation
Economic model	Local or regional economy	Benefit-cost analysis (National Income Accounts)
Results	Change in local jobs and income	Net change in national income

What Are Economic Impacts?

Experience makes us aware of the expenditures made by recreationists seeking enjoyment from wildlife through hunting, fishing, photography, wildlife viewing, and other leisure pursuits, not the least of which is attracting and enjoying wildlife around the home. Since 1955, the U.S. Fish and Wildlife Service has conducted nationwide surveys every 5 years. These surveys have estimated the annual expenditures of sports enthusiasts, recreationists, and more recently, nonconsumptive users seeking to enjoy wildlife. Economic impact analysis determines the portion of those expenditures captured by a particular local economy and then estimates the total effect of those expenditures on businesses and incomes in the community. Conducting an impact analysis calls for knowing which types and what portion of expenditures are made in the recreationist's own community, enroute to the locality, and in the locality where the wildlife recreation takes place.

The recreationist is unlikely to buy much equipment in the recreational location. He or she may buy some gasoline there and also enroute, but will probably fill the tank at home before and after the trip. If the round trip is under 200 miles, all gasoline may be purchased at home. Provisions for a camping trip likely will be purchased at home. Restaurant food and lodging may be the most prominent purchases in the recreational community together with guide and access fees where these are part of the experience.

A dollar spent locally may not enrich the local economy by a full dollar's worth. Suppose a party of hunters buys all its food and lodging at local restaurants and motels. Half the money paid the restaurants and a third of the money paid the motels may be paid to restaurant and motel suppliers outside the region. The remaining payments go to the owners, managers, workers, and taxes. If these owners, managers, and workers are local and there are a variety of local businesses, then they may spend a good portion of their receipts in the local economy.

If the local economy is supplied with a variety of well-stocked local businesses and households to sell to the motels and restaurants and their owners, managers, and workers, then the local income generated by nonresident purchase of meals and lodging may exceed a dollar for every dollar spent by nonresidents. But if the local economy is poorly supplied with local businesses, most of the income benefits derived from wildlife recreation will leak away to larger local economies, and only a small portion of each dollar spent by visitors will generate local income.

The economic impacts generated by nonresident expenditures in a community will grow to the extent the local economy can hold on to the income in successive rounds of expenditures by recipients. The task of economic impact analysis involves knowing enough about a local economy to be able to specify how much of an income and employment effect it receives from nonresident recreational expenditures.

Basic Steps in Regional Economic Impact Analysis and the Role of the Biologist

This section discusses the five steps of regional economic impact analysis in enough detail to help wildlife biologists play an appropriate role in the process. Wildlife biologists are likely to be called upon to participate in the first steps of the analysis. The first steps strongly resemble the basic components of benefit/cost analysis covered in Chapters 2 and 3. Biologists are normally expected to perform a biological analysis and possibly a hunter-day analysis. Economists or specialists with training in regional economic impact analysis would be expected to perform recreation expenditure and regional economic analysis. Managers, with staff participation, would perform the final evaluation and ranking of alternatives. The analysis would typically be performed in the land use planning process where biologists would be part of the team defining the alternatives and ranking the choices after all information is collected. As with benefit-cost analysis, regional economic impact analysis culminates in evaluation and ranking of the alternatives.

The basic steps in regional economic impact analysis follow:

Step 1 - Biological Analysis

Projects the effects of each alternative on wildlife populations in the study area using the limiting factors worksheet or other accepted methods.

Step 2 - User-Day Analysis

Projects the effects of changes in wildlife populations on changes in the amount of wildlife-based recreation to take place in the study area using the hunter day/population or user day/harvest or other accepted methods. Include estimates of nonconsumptive use.

Step 3 - Recreation Expenditure Analysis

Projects the change in wildlife-related expenditures in the area from the change in nonresident and resident fish and wildlife recreation in the area as a result of each alternative. Determines the businesses most dependent on wildlife-oriented recreation, such as commercial outfitters and guides.

Step 4 - Impact Analysis

Estimates income or output and employment effects by sector using the wildlife-related expenditures projected for the local economy and an accepted state-of-the-art method for regional economic analysis.

Step 5 - Evaluating and Ranking

Evaluates and ranks the alternatives using impact on regional income and employment as one factor. In evaluating impacts, considers both relative and absolute size of the impacts.

What Are BLM Requirements?

The need for regional economic impact analysis arises from the need to describe the economic effects of alternative land-use plans or of environmental alternatives. The BLM planning requirements are defined in 43 CFR 1610.4-6; the National Environmental Protection Act (NEPA) requirements are defined in 40 CFR 1502.16. BLM does not prescribe a particular method of regional economic impact analysis (several methods are in use) but instead prescribes standards to be met in estimating the effects of alternative plans. In general, the standards require documentation, quantification, and systematic, interdisciplinary approaches. (See BLM Manual Section 1616.63.)

The Supplemental Program Guidance (BLM Manual Section 1622.12[E]) states that impacts on regional income and employment must be considered in selecting wildlife populations for study in RMP actions. A population is considered important to the regional economy under the following circumstances:

- If nonresidents are attracted to the community to hunt, fish, view, or otherwise enjoy the popula tion.

- If local businesses cater to nonresidents and visitors.

- If local residents who hunt, fish, view, or otherwise enjoy wildlife would leave the community for recreation if the population were not there for their enjoyment.

Approaches to regional economic impact analysis vary among the 11 BLM states. Nearly all the states perform some regional economic impact analysis, but some use local or state models, and some depend on U.S. Forest Service or Water Resources Council models. A few of the BLM state offices have developed their own guidance on regional economic impact analysis, while the rest use general sources.

Appendix IV - Common and Scientific Names of Species

Common Name	Scientific Name
bald eagle	*Haliaeetus leucocephaluls*
basin big sagebrush	*Artemisia tridentata tridentata*
bighorn sheep	*Ovis canadensis*
bobwhite quail	*Colinus virginianus*
chinook salmon	*Oncorhynchus tshawytscha*
cutthroat trout	*Oncorhynchus clarkii*
elk	*Cervus elaphus*
ferruginous hawk	*Buteo regalis*
gray partridge	*Perdix perdix*
Idaho fescue	*Festuca idahoensis*
mule deer	*Odocoileus hemionus*
pileated woodpecker	*Dryocopus pileatus*
pronghorn	*Antilocapra americana*
sage grouse	*Centrocercus urophasianus*
three-tip sagebrush	*Artemisia tripartita*
western wheatgrass	*Agropyron smithii*

Appendix V - Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
AMP	Allotment Management Plan
AHR	Allowable Harvest Rate
AUM	Animal Unit Month
DCF	Discounted Cash Flow
EA	Environmental Assessment
EIS	Environmental Impact Statement
GIS	Geographic Information System
GNP	Gross National Product
HMP	Habitat Management Plan
HSI	Habitat Suitability Index
IAM	Investment Analysis Model
IHICS	Integrated Habitat Inventory and Classification System
JDR	Job Documentation Report
LIS	Land Information System
NEPA	National Environmental Policy Act
RIPS	Resource Improvement Project System
RMP	Resource Management Plan
UTM	Universal Transverse Mercator
WFPA	Wildlife and Fisheries Productivity Analysis

Appendix VI-Glossary

Abiotic - Pertaining to or characterized by the absence of life or living organisms.

Allowable Harvest Rate (AHR) - The percentage of a wildlife population that can be harvested annually without causing a decrease in population size over the long term.

Animal Unit Month (AUM) - The amount of forage necessary to support a cow and a calf for one month (about 800 pounds-air dry).

Benefit-Cost Analysis - The systematic comparison of monetary costs and benefits of a proposed action.

Benefit-Cost Ratio - The discounted benefits of a project or program divided by the discounted costs.

Biological Productivity - The change in numbers of a particular species.

Biotic - Pertaining to life.

Carrying Capacity - The number of individuals of a particular species that the habitat can support indefinitely without deterioration.

Consumptive Recreation - An activity such as hunting or fishing where a resource (e.g., an elk, a fish) is removed from the site for food.

Contingent Value Method - A survey technique for estimating the price a person would pay for an object or experience when no market exists.

Cost - The value of goods and services which must be used to secure a certain result; the amount of money which must be paid.

Decimating Factors - Factors that kill animals directly. Hunting, predators, starvation, diseases, parasites, and accidents are decimating factors identified by Leopold (1933).

Discounted Cash Flow (DCF) Analysis - Analysis of a stream of future dollar amounts that have been adjusted to a present dollar figure by application of an interest rate known as the discount rate.

Economic Efficiency - Making the best use of existing funds and resources. As measured by the benefit-cost ratio, it would be the highest ratio available.

Endangered Species Act - An act passed by Congress in 1973 to protect animals and plants that were in danger of becoming extinct because of mans' activities.

Existence Value - The value assigned to the existence of something (e.g., the Grand Canyon, an elk) that a person may never get to see, but still derives pleasure from knowing that the object is available at some later date.

Forests and Rangelands Renewable Resources Planning Act (RPA) - An act that requires the U.S. Forest Service to prepare a national analysis of projected demands for, and supplies of, the products of the national forests. RPA values are updated every 5 years.

Gross National Product (GNP) Price Deflator for Total Consumer Expenditures - An index maintained by the U.S. Department of Commerce that is used to adjust the value of the nation's consumption to constant prices.

Guild - A group of species that use some part of their environment in the same way.

Habitat Factors - Components of a wildlife population's environment such as food, water, and cover.

Habitat Suitability Index (HSI) Model - A model that specifies the important habitat factors in a species' environment, how the amount of each factor affects the quality of the environment, and how the factors are related to each other. The U.S. Fish and Wildlife Service has constructed a number of HSI models for various wildlife species.

Input - The factors used in economic processes of production; any item required by a process.

Internal Rate of Return - A rate that equates the present value of an expected future series of net cash flows to the present value of the costs, including the initial investment, annual maintenance costs, and replacements.

Limiting Factor - Any habitat factor (or other factor) which surpasses the limits of tolerance for a particular population and prevents that population from increasing.

Market - Any institution or mechanism that brings together the buyers and sellers of a particular good or service resulting in agreement on price and quantities exchanged.

Nonconsumptive Recreation - Recreation in which no resource is removed from the site (e.g., hiking, photography, bird watching).

Nonmarket Good - A good or service which it procured, usually by a person's own activity, without the necessity of having to pay a price in a market for it.

Nonuse Values - Values that exist without either consumptive or nonconsumptive use. These include existence and bequest values.

Optimum Population Level - In WFPA analysis, the population size that would exist when all habitat factors were at optimum levels.

Output - The goods or services resulting from economic processes; the results of any process.

Output/Cost Ratio - The discounted output in physical units, such as animals or acres, divided by the discounted costs. Useful for evaluating different projects with the same kind of single output when no dollar value is known for the output unit.

Present Net Value - The present value of a series of future cash flows discounted at a fixed interest rate.

Price - The amount of money paid for a product that is bought and sold; the amount that would be paid for a product if it were bought and sold.

Price File - A list of dollar values for AUMs and user days stored in IAM for BLM benefit-cost analyses.

Privilege Fee - A fee paid to a private individual for the right to hunt, fish, or otherwise use his land.

Real Markets - A situation where buyers and sellers agree on a price and a product changes hands.

Regional Economic Impact Analysis - Estimation of the effects of alternatives on regional income and employment. This analysis depends only on income that accrues to the local economy and ignores all benefits and costs that are not local.

Sikes Act - An act passed by Congress in 1974 to assist the Secretary of Defense in planning, development, maintenance, and coordination of wildlife, and fish and game conservation, in accordance with cooperative plans mutually agreed upon by the Secretary of Defense, the Secretary of the Interior, and appropriate state wildlife management agencies.

Simulated Markets - A situation where buyers indicate a price they would pay if there were a market for the product they now use free of charge.

Tradeoff Analysis - Analyzing different alternatives in terms of what is gained and what is given up in each alternative.

Travel Cost Method - A technique for estimating recreation benefits where there are no prices paid by using the cost of travel to derive a demand curve for a recreation site.

User Day - All or part of a day spent in some particular use (e.g., hunter day, angler day, recreation day).

Uses Foregone - In an instance where options are given (e.g., fishing or boating on a lake, not both), the option not chosen is a use foregone.

Utility of Use - The satisfaction, and occasionally, happiness that accrues from some use (e.g., successful fishing trip, observering a new bird for a lifelist).

Welfare Factors - Factors in the environment identified by Leopold (1933) that are commonly thought of as habitat factors. These include food, water, cover, and special requirements such as salt or minerals.

Willingness-To-Pay Value - An economic value or price representing the amount an individual or group of persons pays or would pay for a good or service.

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This guide describes procedures developed by the Bureau of Land Management (BLM) to evaluate the biological effects and economic benefits of resource improvements and treatments affecting wildlife populations. The guide provides a basic level of knowledge and understanding of wildlife economics and productivity analysis and BLM's procedures for benefit-cost analysis and project ranking. The guide will support more ecologically sound and economically efficient wildlife management on public lands.

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